Reclaiming the Fugitive Dust: Preserving and Interpreting America's Forgotten History of Nuclear Contamination

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Abstract

Radiologically contaminated sites differ from other heritage places in that the inherent permanence of their materiality creates an imperative for their preservation on a massive timescale. This is cultural heritage at its most crucial, for if our society forgets about the dangers that radioactivity poses - if the message *Do not dig here* does not translate across centuries - then beings generations ahead of our own will be put at risk.

How can preservationists engage in the highly conflicted realm between remediation, destruction and the preservation of significant structures? How can radiologically contaminated places be interpreted in such a way that this history is not forgotten? This work explores a series of three case studies (Uravan, Colorado; West Orange, New Jersey; and Ottawa, Illinois) that illustrate how radiologically contaminated historic environments have been treated during the EPA Superfund cleanup process. The regulatory and policy processes (including Section 106 review) that have led to these preservation outcomes are reviewed and analyzed with an eye towards the lessons learned that could be applied to these unique preservation challenges.

In many cases historic buildings have been demolished to protect human health, but the case studies examined in this thesis show that the tension between remediation and preservation is not intractable. The risk from contamination should always be considered, but it appears that the demolition of radiologically contaminated historic structures is by and large a bureaucratic, legal, and social issue, *not* a strictly technical one. Because of this, as historic preservation professionals we may be able preserve more historic built fabric than we currently realize. The case studies discussed in this work also highlight the importance of community activism in ensuring positive preservation outcomes, and suggest that one of the crucial ways of better integrating preservation in the Superfund remediation process is through improved Section 106 compliance. Even when radiological contamination is so extensive as to require a building's demolition, there are many ways to ensure that this crucial history becomes part of broader public memory.

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Chapter 1: Introduction

Just off Interstate 141 in the midst of the Colorado Plateau lies a pile of stones. When viewed from space this pile is the shape of a giant's baseball diamond, or, depending on one's perspective, a simple house in profile: five sides, walls, floor, peaked roof. The stones are grey, greyer than the surrounding desert that rises away from this valley floor in warm ecru tones, micah-flecked pink sandstone meeting a harsh line of tumbled basalt and granite. A few yards away a faded American flag hangs from a pole. Fifty years ago this site was the small town of Uravan, Colorado. Built next to a uranium mill that operated for decades, Uravan was deemed unfit for human occupation and too radioactive to leave standing. Cleanup crews tore each building in town to bits of shredded timber and frayed drywall and deposited them here for burial. Now, beneath the stones lies Uravan's grave.

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Nuclear history in America has touched many places, from the infamous landscapes of the Manhattan Project to the uranium mines that made the atom bomb possible. In the red deserts of New Mexico Navajo sheep ranchers still drive dust-coated pickup trucks past signs warning of uranium contamination left over from the United States' biggest radioactive spill. In the suburbs of Orange, New Jersey, blue plastic tarps snap in the wind on once-grassy lawns, covering steel drums of radioactive material dug from beneath the neighboring house. At each of these places, radioactive contamination has left an invisible threat behind, a legacy of nuclear extraction, processing, and production. Many sites have since been remediated, and are now safe for human occupation. However, this remediation has been a destructive as well as a healing force. Earth is

moved thousands of miles away. Buildings are crushed into hazmat drums. And most visible traces of the history that happened there are hauled away.

What can be learned from places like Uravan? How can preservationists engage in the highly conflicted realm between remediation, destruction and the preservation of significant structures? How can these places be interpreted in such a way that this history is not forgotten? In this work I will explore a series of case studies that illustrate how radiologically contaminated historic environments have been treated during the EPA Superfund cleanup process. I will examine the regulatory and policy processes (including Section 106 review) that have led to these preservation outcomes, with an eye towards the lessons learned that could be applied to these unique challenges. This thesis will seek to answer the above questions, and to provide recommendations for the preservation treatment and interpretation of radiologically contaminated heritage places.

Rationale

The field of historic preservation is predicated on the notion that our built and cultural environments offer some of our most powerful tools for telling stories about the past. The places where nuclear history has played out have a vital role to play in ensuring that essential knowledge is transferred to future generations. Some sites associated with nuclear history are highly visible and well-interpreted, such as those associated with the Manhattan Project National Historical Park, but many others lack effective place-based interpretation. This thesis will focus on three case studies of lesser-known nuclear heritage sites that have, for various reasons, escaped the widely sewn net of collective memory and are in danger of being forgotten. The stories that these places hold - of thousands of round steel drums loaded with the remnants of

houses and playgrounds; of radon gas seeping quietly into a basement - these stories need to be told, and they need to be told in a way that directly engages with the places where they happened.

Radiologically contaminated sites differ from other heritage places in that the inherent permanence of their materiality creates an imperative for their preservation on a massive timescale.[1] This is cultural heritage at its most crucial, for if our society forgets about the dangers that radioactivity poses - if the message *Do not dig here* does not translate across centuries - then beings generations ahead of our own will be put at risk. Efforts have been made to mark radioactive waste disposal sites for millennia, but conveying risk that far into the future is a nearly impossible task.[2] This is complicated by the fact that human beings cannot observe radiation through sense alone. Therefore, it is essential that knowledge about the danger of radiation, and of where radioactive material has been disposed, is embedded in our culture deeply enough that it is passed down for generations. Many of the case studies presented in this thesis focus on places with low-level radiological contamination, which does not pose the same type of health threat as something like spent reactor fuel. However, it is crucial to acknowledge histories from all aspects of nuclear production, lest in our haste to bury every last scrap of contaminated sheetrock we forget those consequences that cannot be hauled away.[3]

Treating radiological contamination as a heritage resource opens up many questions, but contaminated buildings in particular pose a unique challenge to preservationists. Here are structures that will remain important for thousands of years - a rarity even in a field that

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[1] Radium-226 has a half-life of 1,600 years, while uranium-238 has a half-life of 4.47 billion years. https://www.epa.gov/radiation/radiation-basics.

[2] Samuel Gilbert, "The Man Who Helped Design a 10,000-Year Nuclear Waste Site Marker," *Vice,* April 28, 2018, https://www.vice.com/en_us/article/9kgjze/jon-lomberg-nuclear-waste-marker-v25n1.

[3] Or forget that the history of nuclear production and contamination is wide ranging enough to be found throughout the broader landscape, even, sometimes, in our own backyards.

designates buildings as worthy of standing for perpetuity. In some cases, an association with broad patterns of our nation's history is literally built into the building fabric. Radioactive tailings material was stirred into mortar set between bricks, mixed into concrete foundations as sandy aggregate, and poured as fill material beneath front porches and neighborhood sidewalks. This is all part of our nuclear legacy, and in some ways the permanence of radioactive contamination opens up possibilities for long-term preservation. Yet to preserve these buildings, in many cases, is to preserve an inherent and imminent danger to human health. It is difficult to argue for the preservation of structures that not only represent a negative history, but that also bring that history viscerally into the present with a remaining threat. Preservationists have ceded their fervent commitment to preserving original historic built fabric in other cases, such as lead paint, asbestos, and PCB contamination.[4] However, remediating those contaminants rarely calls for the demolition of the entire structure, and the parts of the building that are impacted are often elements that could reasonably require replacement due to weathering and wear. How, then, can we ensure that this history is preserved and remembered? Somehow, these tensions and conflicts need to be grappled with, and a piece of ground must be found between total obliteration and doing nothing to reduce the inherent risks of contamination. This thesis will attempt to stake that ground.

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The town of Uravan was never intended to be completely flattened into a waste pile. Two historic structures were carefully conserved, only to be set aflame at the eleventh hour due to mold and structural issues. Local residents had planned to use the buildings as a museum, but

[4] Emily J. Sinitski, "Polychlorinated Biphenyls (PCBs): A New Hazard for Historic Buildings*,"* (Master's Thesis, Columbia University, May 2013.)

now nothing remains of Uravan's built environment. The field sits empty, history contained only beneath the surface. Somewhere in this mound the whitewashed walls of the contaminated town post office decay slowly, a process that will continue for thousands of years.

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Methodology and Literature Review

Methodology

This thesis will focus on three cases related to the historic nuclear contamination of residential and industrial sites in the United States. To begin with, 424 sites that were listed, sufficiently remediated, and then deleted from the Superfund National Priorities list since 1980 were coded. Of these sites, twelve were found to have radioactive contamination. Each site was then analyzed based on the historical significance of the contaminating industry and the ways in which remediation was carried out. The U.S. Radium site at Orange, New Jersey was chosen for its associations with the important history of the radium girls as well as the unusually careful way that the site was remediated. The Ottawa, IL site, which had a similar history, was also added to provide a contrasting example of how sites with similar preservation and contamination issues have been dealt with.

The third site (Uravan, Colorado) was chosen because it is a representative example tied directly to the history of uranium mining and milling in the United States. The history of uranium mining is not well known among the general population, which makes it an important target for a case study. There are a multitude of other uranium mines in the American Southwest, and many of them have compelling histories. However, the demolition and burial of Uravan, Colorado occurred on a scale rarely seen elsewhere. The availability of documentation that thoroughly catalogues the remediation process also made it a strong case, and offered more

information on how the preservation process played out than was found in other potential examples. By happenstance the three case studies in this thesis - Uravan, Colorado; Orange, New Jersey; and Ottawa, Illinois - share a similar geographic point of origin. They all have ties to the Paradox Valley of Colorado, where carnotite ore was mined to produce radium and uranium. However, the ways in which the contaminated places these industries left behind were eventually remediated were very different.

In choosing cases I also felt that it was important to avoid cases with histories tied solely to the Manhattan Project. There are several reasons for this. First of all, this is an area that has already received substantial scholarship in the heritage field. Secondly, while there are many parallels between the cases of the selected sites and those associated with the Manhattan Project, the higher level of radioactivity in the contamination found there coupled with the significance of the Second World War open such cases up to differing lines of inquiry. The goals of this thesis are not to grapple with recommendations for the long-term disposal of high-level radioactive waste, for example. Instead, this thesis intends to focus on the "smaller" nuclear histories that, for a multitude of reasons, have not been adequately embedded in our nation's collective memory.

The three selected cases also pose challenges that many Manhattan Project sites do not - namely, these are locations where people are (or were) living and working in close proximity, and, where, in contrast to many Manhattan Project sites, the inherent *placeness* of the problem is not currently acknowledged. This is not to say that interpretation at Manhattan Project sites is perfect - in one particularly galling example, the souvenir stand at the Trinity site has a photo of the wrong mushroom cloud on it[5] - but the role of place is very frequently acknowledged within

[5] Visit to site, October 2017. The pictured mushroom cloud is from Operation Plumbbob.

the larger discourse and scholarship on the topic. Secret cities needed "remote" locations (never mind the indigenous communities already living there),[6] and desert environs make good places for bomb testing. Where, then, does the suburban garage in New Jersey built atop waste from radium dial production fit into this broader nuclear history? This thesis will help answer that question.

This thesis depends almost entirely on existing secondary sources uncovered during the literature review portion of the methodology. There are a multitude of archival documents that will serve as the sources for this research, including EPA Superfund records, historic newspaper articles, historic photographs, existing cultural resource surveys, National and State register building nomination forms, HABS/HAER documentation forms, legal documents, and public notices.

Limitations

Due to the significant time constraints of the thesis process it was not was not possible to conduct interviews or anonymized surveys, which is a major limitation of this research. Ideally, residents of the areas affected by radioactive contamination should play a role in any research conducted about their hometowns, and this thesis lacks their voices except where they appear in the existing public record.[7] More research needs to be done in the future to better understand how communities respond to these issues of contamination and remediation. Because of the disruptive and potentially traumatic nature of environmental contamination, future research should be completed over a much longer time scale to allow the researcher to gain the trust of

[6] Valerie Kuletz, *The Tainted Desert: Environmental and Social Ruin in the American West*, (Routledge, 1998.)
[7] The public record was also diminished significantly due to the COVID-19 crisis, further reducing the opportunity to incorporate community members' perspectives as expressed in previously published documents.

local communities. This topic and others like it would be well served by community-based research methodologies.[8]

Furthermore, this thesis was largely completed from January 2020 to May 2020, during the COVID-19 pandemic. Because of this, many resources (including interlibrary loan programs; on-campus and city and state libraries; and university labs and studios) that would normally be relied upon to produce a work of this scale were not available. Therefore, the resources presented within are largely limited to those that could be accessed via an online source. This is especially problematic for research of this type, as many of the sites and topics discussed are relatively obscure, and would benefit greatly from the inclusion of published and archival material that has not been widely disseminated. There may be gaps in the information presented within this work as a result.

The COVID-19 pandemic also resulted in changes to normally stable government repositories, such as the Environmental Protection Agency's website. Note that bibliographic web links to these and other sources may no longer function, may return error pages, or may display updated or different information, depending on the state of the repository when the link is accessed in the future. All websites were referenced as they appeared as of late February 2020 unless otherwise noted. Furthermore, planned site visits and trips to obtain data from EPA archives could not be completed due to travel restrictions imposed by the COVID-19 pandemic, which also limited the depth of information collected. However, these challenges are far from limited to this work, and have been faced by most researchers during this time frame across the country (and the world). Overall, this thesis aims to discuss the selected topics as thoroughly as possible given the significant limitations imposed on the research process.

[8] Such as Community Based Participatory Action Research.

Literature Review

This thesis draws on a variety of sources, and a review of the relevant literature was carried out as part of this research methodology. Given the limited scope of this thesis, this literature review will focus on topics and sources that relate directly to the case study sites. A thorough review of all literature pertaining to the history of nuclear development in the United States was not completed, though many of the sources referenced here contain a substantial amount of material pertaining to the general historical context. Literature associated with the preservation of contaminated and traumatic landscapes will also be discussed.

Literature on Nuclear Landscapes

Valerie Kultez' book *The Tainted Desert*: *Environmental and Social Ruin in the American West*[9] forms an essential backbone of the literature on radiologically contaminated landscapes and the history of nuclearism in the United States. Kuletz focuses on the American West, and her work traces the establishment of "wastelands" for nuclear production alongside the environmental justice and environmental racism aspects of this history. Kuletz' book covers many sites in detail, including several that have similar aspects to those chosen as case sites in this thesis but that were outside the scope of this work.[10]

A useful and broad-ranging source for more on many of the themes presented in this thesis, especially those related to waste disposal and larger landscapes of extraction, is Lucy R. Lippard's book *Undermining: A Wild Ride Through Land Use, Politics, and Art in the Changing West.*[11] This work offers thoughtful exposition on a variety of uranium mining-related historic

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[9] Valerie Kuletz, *The Tainted Desert: Environmental and Social Ruin in the American West*, Routledge, 1998.
[10] For more on the Navajo communities impacted by uranium mining, see *Yellow Dirt: A Poisoned Land and the Betrayal of the Navajos* by Judy Pasternak (Free Press, 2011) as a starting point.
[11] Lucy R. Lippard, *Undermining A Wild Ride Through Land Use, Politics, and Art in the Changing West* (New York: The New Press, 2014.)

places, most of them in the Southwest, as well as several other instances of tragedy and memorialization across the United States. The book draws on the work of other scholars to create a hybrid style text that uses photographs to reinforce the narratives of the landscapes presented within.

Several authors have also tackled issues of preservation and remembrance at Manhattan Project and other sites associated with nuclear history. Paul Williams discusses the preservation of the B reactor at Hanford, WA in his article "Going Critical: On the Historic Preservation of the World's First Nuclear Reactor."[12] The Atomic Heritage Foundation (now part of the National Museum of Nuclear Science and History) has also made great contributions to preserving nuclear heritage with their collection of hundreds of oral histories from the Manhattan Project. Though not inherently place-based, many of these histories tie in strongly with established heritage places.

The recently published book *The Future of Nuclear Waste: What Archeology and Art Can Tell Us About Securing the World's Most Hazardous Material* by Rosemary Joyce takes a cultural heritage approach to nuclear waste disposal sites.[13] Joyce's work focuses on the process of marking permanent waste disposal sites, and sets these established markers within a framework of past places that have been venerated for their cultural heritage (such as Stonehenge). This book focuses on designated high-level waste repositories, in contrast to the low-level contaminated areas that make up the focus of this thesis. However, waste from many of the sites discussed in this thesis was eventually disposed of in similar sites to those explored

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[12] Paul Williams, "Going Critical: On the Historic Preservation of the World's First Nuclear Reactor," *Future Anterior* 5:2 (Winter 2008), vii-18.

[13] Rosemary Joyce, *The Future of Nuclear Waste: What Archeology and Art Can Tell Us About Securing the World's Most Hazardous Material*, (Oxford University Press, 2020.)

by Joyce, suggesting that her work may be a useful resource that could be scaled down and applied to related landscapes.

Literature on Negative History and Traumatic Landscapes

Kenneth Foote's book *Shadowed Ground: America's Landscapes of Violence and Tragedy* proposes that places with negative or traumatic histories are often dealt with and memorialized (or not) in one of four ways.[14] In it, he argues that the type of history represented (e.g. whether it is shameful or violent) is often associated with a particular form of interpretive outcome. This is useful to keep in mind for the field of historic preservation, especially as this thesis deals with several negative and traumatic sites.

Erica Doss writes about the memorialization process at places with negative histories, with a focus on community-driven temporary memorials.[15] Though the specific type of memorial discussed in *The Emotional Life of Contemporary Public Memorials: Towards a Theory of Temporary Memorials* differs significantly from the permanent monuments often associated with nuclear waste sites, her work provides a useful theoretical framework for how memorials (and the process of memorialization) can help communities overcome the culture of denial associated with death and risk to mark negative histories within the landscape. Doss also offers examples of how memorials can help communities work through loss, grief, and trauma.

[14] Kenneth Foote, *Shadowed Ground: America's Landscapes of Violence and Tragedy*, (Austin: University of Texas Press, 1997.)
[15] Erica Doss, *The Emotional Life of Contemporary Public Memorials: Towards a Theory of Temporary Memorials*, (Amsterdam: Amsterdam University Press, 2008.)

Remediation and Preservation

One of the most useful sources for understanding how preservation has intersected with the EPA Superfund environmental remediation process is a study by Fredrik Quivek. In "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Superfund's Record," he presents evidence from a survey of SHPO's that suggests that the EPA is frequently "delinquent in complying with its obligations under the NHPA" (National Historic Preservation Act).[16] He also discusses a series of cases that illustrate how the EPA has often neglected opportunities to couple preservation with remediation in the past.[17]

The article "Architecture and Environmental Restoration: Remediating Uranium Mill Tailings from Buildings" is also a crucially important source on the technical aspects of environmental restoration.[18] In this brief work James Tepley discusses the problem of uranium mill tailings in buildings, what criteria should be considered when analyzing a contaminated structure, and what remediation approaches are commonly used.

In "Remediation Technology for the Uranium Contaminated Environment: A Review," J. Li and Y. Zhang discuss how environmental remediation can negatively impact the natural environment.[19] Their analysis of physical, chemical, and biological remediation methods may prove useful for those looking to gain an overview of the applicable science of uranium contamination and remediation. Similarly, F.W. Whicket et al. analyze environmental

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[16] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Superfund's Record," *The Public Historian,* 23:2 (Spring 2001), 48.
[17] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation," 48.
[18] "Architecture and Environmental Restoration: Remediating Uranium Mill Tailings from Buildings." In *Environmental Remediation '91 : Cleaning up the Environment for the 21st Century : Proceedings of the ER'91 Conference at Pasco, Washington, September 8-11, 1991.*
[19] J. Li and Y. Zhang, "Remediation Technology for the Uranium Contaminated Environment: A Review" *Procedia Environmental Sciences* 13 (2012). 1609-1615.

remediation outcomes at contaminated Department of Energy sites in "Avoiding Destructive Remediation at DOE Sites," which also focuses largely on the natural environment.[20]

Histories of Selected Case Study Sites

Many of the case study sites discussed in this thesis have been written about extensively. For more information on the history of Uravan, Colorado, see *Uravan, Colorado: One Hundred Years of History.*[21] This short book was put together by members of the Rimrocker Historical Society with funding from Umetco Minerals Corporation. It provides a general overview of the town's history. *Standard Chemical Company: A Collection from Rimrocker Historical Society* also offers a selection of images and historic documents related to the founding of Uravan and of the early years of Standard Chemical.[22] For more on early radium production in the United States, *Radium City* provides a thorough peek into the neglected history of radium production in Pittsburgh, Pennsylvania.

The Radium Girls: The Dark Story of America's Shining Women by Kate Moore[23] and *Radium Girls: Women and Industrial Health Reform* by Claudia Clark[24] both offer extremely thorough histories of the Radium Girls at both Orange, New Jersey and Ottawa, Illinois. Clark's work provides a more academic look at the subject within the context of the history of labor and industrial health reform, while Moore's book provides a more detailed overview of the girls' life and accomplishments for more general audiences. The radium industry and its impact in Ottawa,

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[20] F.W. Whicker, T.G. Hinton, M.M. MacDonell, J.E. Pinder III, and L.J. Habegger, "Avoiding Destructive Remediation at DOE Sites," *Science* 303 (March 2004), 1615-1615.
[21] John S. Hamrick, Diane E. Kocis, and Sue E. Shepard, *Uravan, Colorado: One Hundred Years of History,* Grand Junction: Umetco Minerals Corporation, 2002.
[22] *Standard Chemical Company: A Collection from the Rimrocker Historical Society, (*The Rimrocker Historical Society, 2007.)
[23] Kate Moore, *The Radium Girls: The Dark Story of America's Shining Women,* (Naperville: Sourcebooks, 2017.)
[24] Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935,* (Chapel Hill: University of North Carolina Press, 1997.)

IL was also chronicled in 1987 film *Radium City*, which gives viewers the chance to hear from some of the surviving radium girls in their own words.[25]

Background

Superfund Overview

The sites presented as case studies in this thesis are all Superfund sites. The Superfund process is set up under CERCLA, which stands for the Comprehensive Environmental Response, Compensation, and Liability Act. This act was passed in 1980, and provides "broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment."[26] Sites that pose a risk to human health have to meet certain criteria before they are listed on the Environmental Protection Agency's (EPA) National Priorities List (NPL) and become a part of Superfund. [27]

The primary goal of Superfund is to provide a plan for long-term clean-up of a site. However, it often takes years for Superfund sites to reach the point where they have undergone a full remediation and can be deleted from the NPL. Generally, Superfund sites are only deleted once they are determined to no longer pose a carefully defined risk to public health. Typically this happens once contaminated material is removed or treated, but it can also be achieved by implementing "institutional controls" that aim to ensure that people never come into contact with the toxic material that remains.[28]

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[25] *Radium City*, directed by Carole Langer (1987), Film.
[26] United States Environmental Protection Agency, "Superfund: CERCLA Overview," accessed February 2020, https://www.epa.gov/superfund/superfund-cercla-overview.
[27] United States Environmental Protection Agency, "NPL Site Listing Process," accessed February 2020, https://www.epa.gov/superfund/about-superfund-cleanup-process#tab-2.
[28] United States Environmental Protection Agency, "Superfund: National Priorities List Deletion," accessed February 2020, https://www.epa.gov/superfund/superfund-national-priorities-list-deletion.

However, there is an inherent tension between the Superfund environmental remediation process, which frequently requires that contaminated buildings are demolished for the sake of public health, and the preservation of the historic built environment. One of the ways in which this tension is negotiated through official channels is through Section 106 review.

Section 106 and Section 2 of the NHPA

Because Superfund sites often use Federal funds for remediation, historic resources that fall within a Superfund site are generally subject to Section 106 review. Section 106 of the National Historic Preservation Act of 1966 governs all Federal "undertakings" as they relate to historic properties.[29] Essentially, Section 106 requires that Federal agencies consult with local preservation organizations regarding any potential impact to historic resources prior to the point where work is carried out. It's important to note that this law does not prevent Federal undertakings that could have a negative impact on a historic property - only that the relevant agencies be consulted ahead of time.[30]

As will be discussed in the following case studies, Section 106 has not always been followed during the Superfund environmental remediation process. A 1999 study by Fredric Quivik found that a significant number of State Historic Preservation Offices felt that EPA Superfund projects were not in compliance with Section 106, and that remediation projects were frequently being carried out in their states without any consultation with their offices.[31] This may

[29] Section 106 of the National Historic Preservation Act, "Effect of Undertaking on Historic Property," accessed May 2020, https://uscode.house.gov/view.xhtml?req=(title:54%20section:306108%20edition:prelim)%20OR%20(granuleid:USC-prelim-title54-section306108)&f=treesort&edition=prelim&num=0&jumpTo=true.

[30] Section 106 of the National Historic Preservation Act, "Effect of Undertaking on Historic Property."

[31] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Superfund's Record," *The Public Historian,* 23:2 (Spring 2001), 47-61.

have improved slightly in recent years, but likely remains an ongoing issue. The Environmental Protection Agency has guidelines on how Section 106 compliance can be interwoven into the remediation process, and these guidelines reveal a lot about the agency's official view of this aspect of the law. In a slideshow presentation intended to educate federal employees on the requirements of CERCLA and the NHPA, the two laws are presented as being entirely at odds with each other.[32] On a slide entitled "One Designed to Change Effects, the Other to Effect Change," the author writes that:

> NHPA was designed to change the effects of progress on the places important to communities...CERCLA was designed and determined to do the opposite of NPHA – to effect change.[33]

This suggests that the EPA may still proceed with Superfund projects in a way that frames historic preservation as the antithesis of environmental remediation under the law.

Section 2 of the National Historic Preservation Act also has some bearing on federally funded environmental remediation processes such as those completed under Superfund. As shown in the law, it is a stated goal of the Federal Government to generally foster the preservation of the historic built environment. However, particularly when it comes to some of the case sites in this thesis, there are many challenges associated with administering federally-owned historic properties in the "spirit of stewardship for the inspiration and benefit of present

[32] Earl Liverman, "National Historic Preservation Act Section 106 Review Under the Comprehensive Environmental Response, Compensation, and Liability Act." Slide presentation, accessed May 2020. https://cluin.org/conf/tio/NARPMOSCAcadpresents1/slides/1Slide_Presentation_for_Earl_Liverman,_Retired_EPA_Region_10_OSC,_Acme.pdf.

[33] Liverman, "National Historic Preservation Act Section 106 Review."

and future generations"[34] when those properties are contaminated with radioactive waste. The government's own directives and regulations may conflict quite severely in these instances.

Nuclear Contamination

Nuclear contamination can take a variety of forms. This thesis deals primarily with low-level waste, which is different from the nuclear material used in a power plant, for example.[35] All of the sites discussed in this thesis were contaminated with some form of radioactive waste, often in the form of industrial remnants such as the tailings from uranium mining, milling, or processing. Tailings material poses an interesting remediation and preservation challenge because it is often built into a building in the form of aggregate added to concrete. Enormous volumes of tailings material were incorporated into the built environment in many locations throughout the United States during the first half of the 20th century.[36] Leftover tailings, which were sandy in appearance, were also used as a fill material. The title of this thesis originates from the term "fugitive dust," which is contaminated nuclear material, such as tailings, that has been dispersed into the surrounding landscape.

Other radiological contamination that will be discussed arises from radium, such as radium paint. Once buildings are contaminated with radium or uranium they can go on to threaten other buildings if they are demolished and used as fill underneath other areas of new construction. This occurred in both Ottawa, Il and Orange, NJ, for example.

These types of contaminants pose a multitude of risks, including both gamma radiation and radon gas. Radon gas is produced by the decay of uranium, radium, and or other radioactive

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[34] Section 2 of the National Historic Preservation Act, accessed May 2020, https://www.nps.gov/history/local-law/nhpa1966.htm.

[35] In other words, this isn't Chernobyl.

[36] The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times*, April 12, 1970.

materials such as thorium. The colorless and odorless nature of radon makes it difficult to detect. It can easily build up in enclosed spaces such as homes or basements.[37] As radon gas decays, short-lived radioactive particles, called daughter products, are formed.[38] One of the major human health risks associated with radon is lung cancer from breathing in these radioactive particles.[39] Estimates from the U.S. Environmental Protection Agency suggest that radon is responsible for about 21,000 lung cancer deaths in the United States each year.[40]

Gamma radiation can also pose a threat to building occupants. Unlike alpha radiation, gamma radiation has the power to penetrate the skin, and can have so much penetrating power as to pass through a few feet of concrete.[41] As gamma rays pass through the human body they can cause ionizations that damage tissue and DNA.[42] Because of this, gamma radiation poses significant health risks. According to the EPA, chronic exposure to high levels of substances such as radium can result in an increased incidence of bone, liver or breast cancer.[43]

Uranium will eventually decay into radium, which then can have the same impact as far as daughter products such as radon and gamma radiation. One of the most important aspects of radiological contamination is how long it will continue to be harmful into the future. This has major implications for the preservation, remediation, and interpretation of radiologically contaminated sites. Below are some of the half-lives of isotopes commonly found in the historic contaminated built environment.

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[37] National Institute of Environmental Health Sciences, "Radon," accessed May 2, 2020, https://www.niehs.nih.gov/health/topics/agents/radon/index.cfm.
[38] National Institute of Environmental Health Sciences, "Radon."
[39] National Institute of Environmental Health Sciences, "Radon."
[40] National Institute of Environmental Health Sciences, "Radon."
[41] [41] United States Environmental Protection Agency, "Radiation Basics," accessed May 2020. https://www.epa.gov/radiation/radiation-basics.
[42] US EPA, "Radiation Basics."
[43] United States Environmental Protection Agency, "Radionuclide Basics: Radium," accessed May 2020. https://www.epa.gov/radiation/radionuclide-basics-radium.

Radium-226 has a half-life of 1,600 years.[44]

Uranium-234 has a half-life of 244,000 years.[45]

Uranium-235 has a half-life of 700 million years.[46]

Uranium-238 has a half-life of 4.47 billion years.[47]

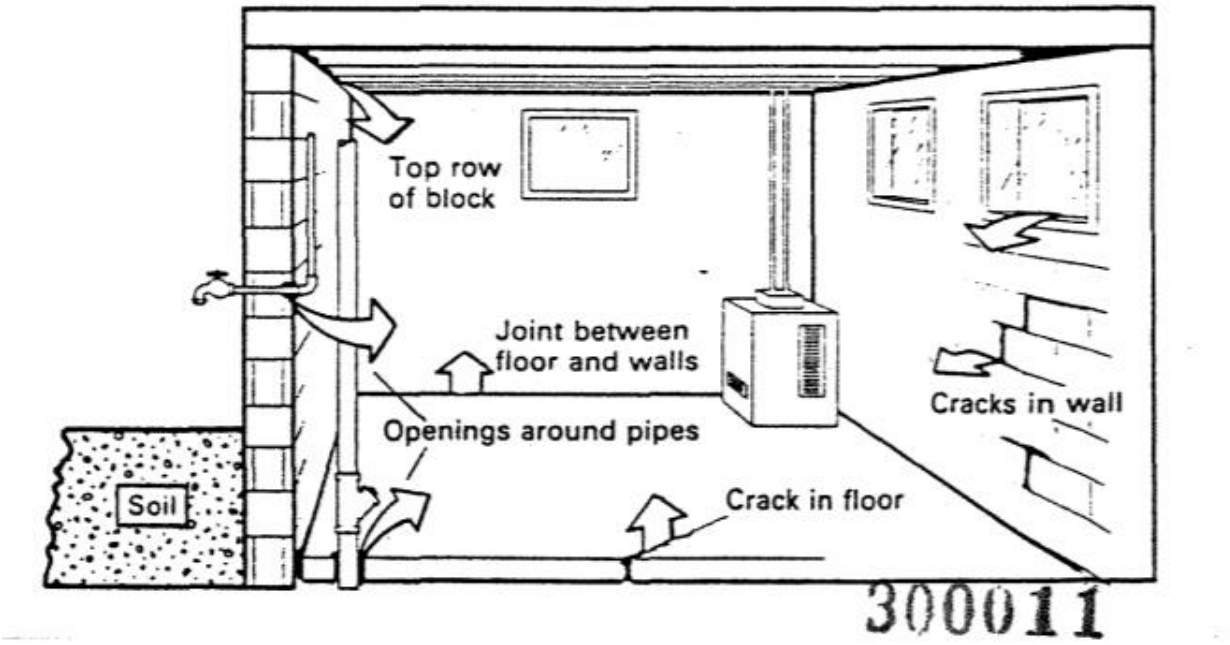

Figure 1.1: Infographic showing how radon can infiltrate a building from radioactive material buried in surrounding soil. Source: US EPA, "A Guide to Radon for Montclair, West Orange, and Glen Ridge Residents."

[44] National Institute of Environmental Health Sciences, "Radon."

[45] United States Environmental Protection Agency, "Radionuclide Basics: Uranium," accessed May 2020, https://www.epa.gov/radiation/radionuclide-basics-uranium.

[46] US EPA, "Radionuclide Basics: Uranium."

[47] US EPA, "Radionuclide Basics: Uranium."

Remediation and the Historic Environment

Radioactive material cannot be neutralized, it can only be moved somewhere else. Because of this, buildings and landscapes that have been contaminated with radioactive material are often demolished to reduce the potential for negative health effects. There are very few established guidelines for dealing with historic structures that have been contaminated with radioactivity in a way that leaves the building intact. Generally, the threat to public health takes precedence over saving the building as it stands, and even in cases where buildings are considered highly significant, demolition is frequently the end result. There is also a complicated legal and technical landscape to contend with that may make it difficult to leave a structure as is. Remediating buildings while keeping them intact must also be done carefully, and is often much more expensive than simply demolishing them outright. This will be discussed further in Chapter 4, which covers the case of Orange, New Jersey.

The strong tension between removing radiologically contaminated, potentially harmful material and preserving important histories dates back at least to the Trinity Test explosion. On July 16, 1945 the world's first atomic bomb was exploded at the Trinity Test in New Mexico. A sea of green radioactive glass dubbed Trinitite stretched for 400 yards around a massive crater.[48] Almost immediately after the test, the National Park Service and others saw the historic nature of the site and began to advocate for its preservation as a monument.[49] However, the crater of radioactive Trinitite and most of the associated buildings were eventually demolished.[50] The site is open to the public on two days per year, but tension still exists between public safety and historic interpretation.

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[48] Ferenc Morton Szasz, *The Day the Sun Rose Twice*: *The Story of The Trinity Site Nuclear Explosion, July 16 1945*, Albuquerque: University of New Mexico Press (1984), 161.
[49] Ferenc Morton Szasz, *The Day the Sun Rose Twice*, 163.
[50] Ferenc Morton Szasz, *The Day the Sun Rose Twice*, 165.

Chapter 2: Uravan, Colorado

Overview

This chapter will discuss the history of the town of Uravan, its radiological contamination, and the preservation issues that emerged during its cleanup. Because the entire town was eventually demolished as part of the remediation process, Uravan is an extremely compelling case. This case study also yielded a larger volume of research information than the following two case sites, and for these reasons it is analyzed at a greater depth.

Early History: Standard Chemical Company, 1910-1930

The story of Uravan begins with a funeral. On June 7th, 1910, a woman named Ellen Murphy died at home in her family's brick Tudor-revival style house at 4725 Bayard street in Pittsburgh, Pennsylvania.[51] The cause was advanced uterine cancer. Her body was interred at Calvary Cemetery in Pittsburgh.[52] A simple stone marker reads "Nellie F. Murphy 1856-1910".[53] She was 54 years old. Her brother, Joseph Flannery, had tried hard to find a source of radium that might have saved her from cancer, but it was too late.

At the time of Ellen (Nellie) Murphy's cancer diagnosis a year earlier in 1909, Joseph was busy running the American Vanadium Company.[54] The early 1900's were an especially unpleasant time to be a woman with gynecological cancer - terribly aggressive abdominal

[51] "Deaths," The Pittsburgh Press, June 9, 1910.
[52] Betty Muschar, "Ellen A "Nellie" Flannery Murphy," May 27, 2013, https://www.findagrave.com/memorial/111273971/ellen-a-murphy/photo.
[53] Muschar, "Ellen A "Nellie" Flannery Murphy."
[54] Joel Lubenau and Edward R. Landa, *Radium City: A History of America's First Nuclear Industry,* (Pittsburgh: John Heinz History Center, 2019), 14, 29, https://www.heinzhistorycenter.org/magazine/Radium-City.pdf

surgeries were commonplace, but they frequently failed to improve survivability.[55] Radium, however, was renowned for its ability to destroy human tissue, and many doctors in Europe had started using vials of the substance to treat cancer.[56] Flannery had heard about the early promises of radium, and he was optimistic that it might be used to cure Nellie's ailment.[57] At the time, only three doctors in the United States were using radium for medical purposes, and radium was only commercially available in Europe.[58] Joseph travelled there in January 1910 an attempt to obtain radium to treat Nellie, but he was unsuccessful.[59]

The question of whether or not Nellie was ever treated with radium is frequently ignored in published histories. Many accounts simply refer to her as Flannery's sister, without mentioning her name, though Flannery is commonly credited for his chivalry in trying to obtain a cure for her. Perhaps, as has been suggested, he was simply playing out a "tycoon's act of grief."[60] Maybe he thought he could save others like his sister (in fact, his decision to start Standard Chemical would eventually lead to the deaths of dozens of young women like her). But regardless of his motivations, radium production could net Flannery a lot of money, and he was in a good position to capitalize on the emerging market.

After Nellie's death, in late 1910 Joseph Flannery withdrew from the American Vanadium Company and started Standard Chemical Company. In late 1910 he sent representatives to the Paradox Valley in Colorado to obtain further mining rights.[61] By the end of

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[55] Ornella Moscucci, "Gender and Cancer in Britain, 1860–1910," American Journal of Public Health 95, no. 8 (August 2005): 1312-1321. https://doi.org/10.2105/AJPH.2004.046458
[56] Lubenau and Landa, *Radium City*, 29.
[57] Lubenau and Landa, *Radium City*, 29.
[58] Lubenau and Landa, *Radium City*, 29.
[59] Lubenau and Landa, *Radium City*, 30.
[60] Peter Hessler, "The Uranium Widows," *The New Yorker*, September 13, 2010. https://www.newyorker.com/magazine/2010/09/13/the-uranium-widows.
[61] Lubenau and Landa, *Radium City*, 32.

the year Kenneth Hequembourg, who had been named superintendent of the project, had established a temporary camp headquarters in the valley.[62] The settlement that would later be called Uravan was born.

However, it is important to acknowledge that Uravan was not situated on empty "virgin" land. The area around what would become Uravan had been occupied by the Ute people for millennia. By the time Flannery's representatives arrived in the Paradox Valley, the Ute people had already been subjected to decades of war, forced relocation, and broken treaties at the hands of white "settlers".[63] In 1868 the U.S. government attempted (and failed) to divest the Utes of their land rights, but they refused to relinquish them.[64] Several years later in 1873 the Brunot Agreement was signed, and the Ute people were forced to move to a narrow band of land in the Four Corners area.[65] The Brunot Agreement "is most often remembered by Utes as the agreement when their land was fraudulently taken away".[66] The poisoning of Uravan residents would not begin for many years. But the site where Uravan was located was already a site of trauma.

By January 1913, Flannery's experimental production had netted 2.1 grams of radium, and Standard Chemical Company announced that they would commence commercial production.[67] Later that year, the Standard Chemical Company site was granted a post office by the U.S. government, and the settlement was named Joe Jr., after Joseph Flannery's son.[68] The centrally located mill was crucial for processing and concentrating the carnotite ore that was

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[62] Lubenau and Landa, *Radium City*, 31.
[63] Southern Ute Indian Tribe, "Southern Ute Indian Tribe History," last modified 2020, accessed April 2020, https://www.southernute-nsn.gov/history/.
[64] Southern Ute Indian Tribe. "Southern Ute Indian Tribe History."
[65] Southern Ute Indian Tribe. "Southern Ute Indian Tribe History."
[66] Southern Ute Indian Tribe. "Southern Ute Indian Tribe History."
[67] Lubenau and Landa, *Radium City*, 33.
[68] Lubenau and Landa, *Radium City*, 41.

being mined nearby, and at the time it employed about 30 men.[69] They were housed in the two-story Joe Jr. boarding house, which was constructed in ca. 1912.[70] By 1914 the small mining camp included the mill, the boarding house, a laboratory, a commissary, and a series of semi-permanent tents.[71] [72] While the majority of the men were single, some had moved to Joe Jr. with their wives and children, so a tent school was also erected to serve the burgeoning young population.[73]

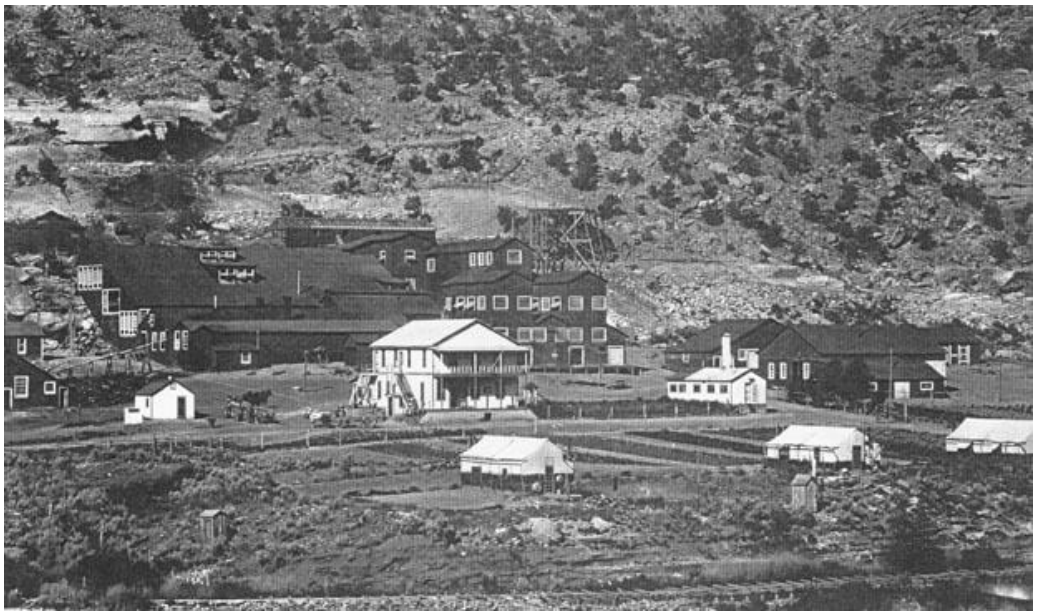

Figure 2.1: Joe Jr. Camp and Mill, ca. 1919. The two-story white building in the center is the boarding house. Source: Ruth Johnson, http://www.uravan.com/pictures.asp?category=2&id=11.

[69] Lubenau and Landa, *Radium City*, 40.
[70] James E. Fell and Eric Twitty, "The Mining Industry in Colorado," National Register of Historic Places Multiple Property Documentation Form, Accessed April 22, 2020, https://www.historycolorado.org/sites/default/files/media/document/2017/651.pdf.
[71] Lubenau and Landa, *Radium City*, 41.
[72] Micheal Amdunson, *Yellowcake Towns: Uranium Mining Communities in the American West* (Boulder: University Press of Colorado, 2002), 3.
[73] Amdunson, *Yellowcake Towns: Uranium Mining Communities in the American West*.

Lower-grade carnotite ore was milled at the Joe Jr. mill, then shipped by pack burro and train to Canonsburg, Pennsylvania for further processing (high-grade ore went straight to the plant).[74] Canonsburg had many of the amenities that the Paradox Valley lacked, including easy rail access, a skilled population of available workers, and sewer, water, and electrical service.[75] Joseph Flannery knew that the vanadium in the ore could be a profitable byproduct, and so the plant was equipped to extract vanadium as well as radium.[76] The final processing and packaging of the radium material took place at the Vanadium Building in downtown Pittsburgh.[77]

Extracting a single gram of radium required 500 tons of carnotite ore, 500 tons of laboratory chemicals, 10,000 tons of distilled water, and 1,000 tons of coal.[78] Yet the material was so precious that this was an extremely profitable business model, despite the massive amounts of material involved. In 1914, a gram of radium sold for $120,000, an incredible sum at the time.[79]

When the Joe Jr. mill was first constructed, uranium was far from a commercially viable product on its own. It was seen as a waste product, and carnotite ore was sorted for uranium content only because of its associated radium.[80] One of the few ways uranium was used was as a colorant in ceramic glazes and glass.[81] What is now called “Uranium”, “Vaseline”, or “Canary” glass by collectors[82] was colored green or yellow by adding uranium oxide to molten glass

[74] Lubenau and Landa, *Radium City*, 39.
[75] Lubenau and Landa, *Radium City*, 53.
[76] Lubenau and Landa, *Radium City*, 53.
[77] Lubenau and Landa, *Radium City*, 33.
[78] Lubenau and Landa, *Radium City*, 54.
[79] Lubenau and Landa, *Radium City*, 76.
[80] Lubenau and Landa, *Radium City*, 39.
[81] Lubenau and Landa, *Radium City*, 80.
[82] There is a small but fervent community of Vaseline glass collectors, some of whom hold an annual convention. A quote about the sales portion of the event: “It was like a feeding frenzy in the Amazon River!” See https://www.vaselineglass.org/.

during the manufacturing process.[83] However, the market was limited, and Standard Chemical Company was producing much more uranium than was needed for novelty glass products.[84] In 1914, Joseph Flannery complained about the vast quantities of uranium extracted during the milling process:

> We have on our hands now probably 100,000 pounds… it is stacked up as high as the ceiling. We can not do a thing with it.[85]

However, Standard Chemical Company was eventually successful in creating a small niche market for high-speed cutting tools made of uranium strengthened steel, which allowed them to sell the waste product.[86] The milling operation also produced thousands of tons of mill tailings, which were considered similarly worthless.[87] Despite his best attempts to create a market for "waste" uranium, the metal never became profitable in Joseph Flannery's lifetime.[88] By the mid 1920's his radium empire would begin to falter.

Joseph Flannery fell ill with an undisclosed ailment in 1919, and on January 18th, 1920, he died at his home in Pittsburgh.[89] The company's legal council, James C. Gray, was elected president of Standard Chemical.[90] By 1921, the Joe Jr. Mill was well established.[91] World War I had decreased the demand for medical radium but increased the overall demand for radium, with

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[83] Lubenau and Landa, *Radium City*, 80.
[84] Lubenau and Landa, *Radium City*, 80.
[85] Lubenau and Landa, *Radium City*, 80.
[86] Lubenau and Landa, *Radium City*, 81.
[87] Standard Chemical also came up with an even more creative use for the mill tailings, which was to market them as a fertilizer additive. Years later, nurseries that had purchased the tailings fertilizer were clearly identifiable from their radioactive emissions, and at least one was included in EPA cleanup efforts. The tailings were also sold as paving material to fill potholes in Canonsburg streets. Lubenau and Landa, *Radium City*, 76-83.
[88] Lubenau and Landa, *Radium City*, 83.
[89] Lubenau and Landa, *Radium City*, 88.
[90] Lubenau and Landa, *Radium City*, 9.
[91] Amduson, *Yellowcake Towns Uranium Mining Communities in the American West*, 4.

much of it to be used in luminous dials.[92] In 1917 Standard Chemical had created the Radium Dial Company as a subsidiary, and within a few years the company was producing luminous watch dials at a factory in Ottawa, IL to capitalize on that demand.[93] By 1921 Standard Chemical Company had extracted 48,00 tons of ore from the Paradox Valley, comprising 92% of all U.S. radium ore extraction.[94] The company had drilled and mapped 6,000 exploratory boreholes in and around Paradox Valley and eastern Utah in search of carnotite ore.[95] They had produced half of the world's supply of radium after only eight years of production.[96]

However, in November 1922 the Belgians announced that they had discovered a new source of radioactive pitchblende,[97] and the price of radium dropped to $70,000/gram.[98] Standard Chemical Company could not compete, and they stopped producing radium that same year.[99] At the Joe Jr. Mill 250 workers were laid off.[100] A year later In 1923 the Joe Jr. Mill and camp was closed down, and the remaining workers and their families moved elsewhere.[101] The site was left empty.

[92] Lubenau and Landa, *Radium City*, 0.
[93] See chapter 4 for a discussion of Ottawa, IL.
[94] Lubenau and Landa, *Radium City*, 117.
[95] Lubenau and Landa, *Radium City*, 38.
[96] Lubenau and Landa, *Radium City*, 9.
[97] This pitchblende was in the colonized areas of what is now the Democratic Republic of Congo. Uranium mining has historically been localized on colonized and inidegenous lands across the globe, a history that continues to this day. Amdunson, *Yellowcake Towns: Uranium Mining Communities in the American West,* 4.
[98] "Radium $70,000 a Gram: $50,000 Drop Is Due to Belgian Congo Find of Rich Ore," *The New York Times,* November 29, 1922.
[99] Amdunson, *Yellowcake Towns,* 5 and Lubenau and Landa, *Radium City*, 9.
[100] "Radium $70,000 a Gram," *The New York Times.*
[101] Amduson, *Yellowcake Towns Uranium Mining Communities in the American West,* 5.

U.S. Vanadium: 1930-1940

In early 1935, the United States Vanadium Company purchased the Paradox Valley property from Standard Chemical Company.[102] A contest was held to name the town, and the winning selection was Uravan, after Uranium and Vanadium, the two minerals that were to be mined and processed at the site. In 1936 U.S. Vanadium constructed a 100-ton mill to process vanadium, replacing the Joe Jr. Mill facilities.[103] By early 1937 the mill was mining and handling 175 to 200 tons of carnotite ore per day with a staff of 145 men.[104] Vanadium was in "great demand" at the time,[105] though the company would not add uranium production for several more years. Around 60 families made their homes in Uravan.[106] Forty-seven "modern and comfortable" houses had been constructed along with a general store, drug store, office facilities, "amusement places", a schoolhouse, and "other buildings essential to a progressive little mining city".[107] The Joe Jr. boarding house also remained from the Standard Chemical Company era. The small town had its own water system and an electric power plant.[108]

[102] "The Past Year Has Been an Eventful One in the Slope's Mining History," *The Daily Sentinel,* January 1, 1937.
[103] "The Past Year," *The Daily Sentinel.*
[104] "The Past Year," *The Daily Sentinel.*
[105] "The Past Year," *The Daily Sentinel.*
[106] "The Past Year," *The Daily Sentinel.*
[107] "The Past Year," *The Daily Sentinel.*
[108] "The Past Year," *The Daily Sentinel.*

Figure 2.2: Standard Chemical Co. Mill, date unknown. Source: Center of Southwest Studies, photographer Philip Schools. https://mesa.marmot.org/Archive/fortlewis%3A18574/LargeImage.

Somewhere, in the construction of all of these structures, the builders found a leftover pile of tailings sand from the Joe Jr. Mill. They spread the material as fill, levelling the valley floor into a series of compact rectangles, prime for home construction.[109] For years the tailings would release radon gas as contamination from the milling operations continued to infiltrate virtually every building in town. Eventually, the tailings piles used in the construction of dozens of communities around the United States would come to light as frenetic clicks on a radiation detector. But that was years in the future. For now, Uravan continued to grow.

By the late 1930's the mill was running at full capacity around the clock.[110] The town had its own baseball team, dubbed the Uravan Miners.[111] The population topped 700 residents.[112] A

[109] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times,* April 12, 1970.
[110] "Uravan Vanadium Mill Operating at Full Capacity," *The Times-Independent,* March 24, 1938.
[111] "Shell Tops Mine Team," *The Daily Sentinel,* June 13, 1938.
[112] "Uravan Extends Mill Operations," *The Times-Independent,* October 26, 1939.

uranium mill was under construction, and a new generator was built to power it.[113] A news article about the forthcoming mill highlighted uranium's previous status as a discarded waste product.

> During its entire operation on vanadium the uranium bearing portion of the ore has gone to great dumps which now consist of thousands of tons. The uranium will be taken from this ore when the new department is completed. The development is not the result of present world war conditions but rather to enable the U.S. Vanadium corporation to better handle the U.S. trade. The expansion at this time comes as a normal development program rather than as a war baby.
>
> --"Uravan Extends Mill Operations," *The Times-Independent*, October 26, 1939.

However, despite the media's assurances, the ramping up of uranium processing was, in fact, tied directly to World War II. Obtaining uranium was part of the biggest war baby of all, the Manhattan Project. If the residents of Uravan had not been involved in the war effort prior to 1940 they would soon be.

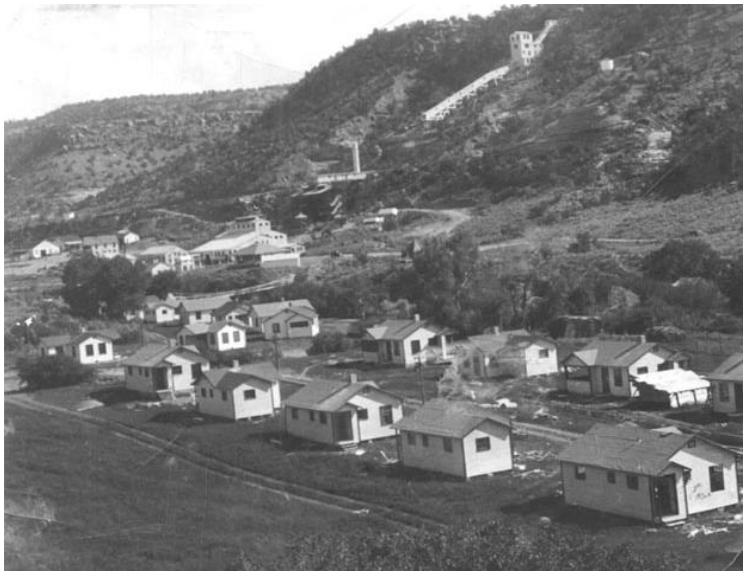

Figure 2.3: The "A Block" and B Block" houses in Uravan, ca. 1936. Source: Debbie Stone Crawford, http://www.uravan.com/pictures.asp?category=6&id=31.

[113] "Uravan Extends Mill Operations," *The Times-Independent.*

World War II: The Rise of Uranium

"The atomic age commodified uranium into the most important metal in the world"

--Micheal Amdunson, Yellowcake Towns: Uranium Mining Communities in the American West (Boulder: University Press of Colorado, 2002), 4.

An oft-repeated story that typifies Uravan during World War II is that of Cliff Hiett,[114] who lived at the town and worked at the mills until he was drafted into the U.S. Army in 1940. Heitt was shipped to basic training in Virginia and then sent to the Manhattan Project site at Oak Ridge, Tennessee.[115] However, once his supervisors realized that he had experience with uranium milling, he was promptly transferred back home to Uravan to help the war effort by overseeing the mill operations.[116] By 1940, uranium had become a crucial material in the war effort, and the U.S. government was doing everything they could to produce more of it.

In 1942 the U.S. Army Corp of Engineers established the Manhattan Engineer District with the goal of developing reserves for atomic weapons production.[117] Later that year they contracted with U.S. Vanadium to build a second mill in Uravan.[118] This mill reprocessed tailings sands from Uravan and surrounding mines to extract any remaining uranium content.[119] Thirty-one military personnel were assigned to run the mill.[120] A second tailings reprocessing facility was constructed in 1944 to capture any stray uranium in the massive hillside tailings pile

[114] "Worker Stories." Cold War Patriots. Accessed April 22, 2020. https://coldwarpatriots.org/about-us/our-nuclear-nation/worker-stories/
[115] Worker Stories." Cold War Patriots.
[116] Worker Stories." Cold War Patriots.
[117] John S. Hamrick, Diane E. Kocis, and Sue E. Shepard, Uravan, Colorado: One Hundred Years of History (Grand Junction: Umetco Minerals Corporation, 2002) 6.
[118] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 6.
[119] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 6.
[120] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 33.

that had grown near the San Miguel River.[121] The "greensludge" produced at the mills was then sent to Grand Junction, Colorado where it was refined into yellowcake uranium.[122]

The town of Uravan grew to accommodate the rise in production capacity spurred by World War II. By the early 1940's the town had spread out in the narrow valley, which constricted its street grid to a series of loop roads that ran in parallel to the canyon walls.[123] Houses faced south, and were typically simple wood-frame structures with a gable roof.[124] A trailer court housed miners, and single men often lived in the boardinghouse.[125] The community building, which was erected in 1939, served as the primary gathering place.[126] [127] After the events of Pearl Harbor the town of Uravan was fenced in for security purposes, and everyone had to show a pass to get through the gates.[128] As in other communities that played a role in the development of the Atomic bomb, most workers had no idea what the end goals of their increased production might be.[129]

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[121] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 6.
[122] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 33.
[123] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 43.
[124] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 43.
[125] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 45.
[126] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 45.
[127] Marty Alexandroff, "Historic Context of Uravan, Colorado, 1881 to 1984," Prepared for Umetco Minerals Corporation, Museum of Western Colorado, and the Town of Naturita, February 1995. http://montrosecounty.granicus.com/DocumentViewer.php?file=montrosecounty_978c80591bc2142758aac3c1d8a87866.pdf.
[128] Alexandroff, "Historic Context of Uravan," 19.
[129] Alexandroff, "Historic Context of Uravan," 19.

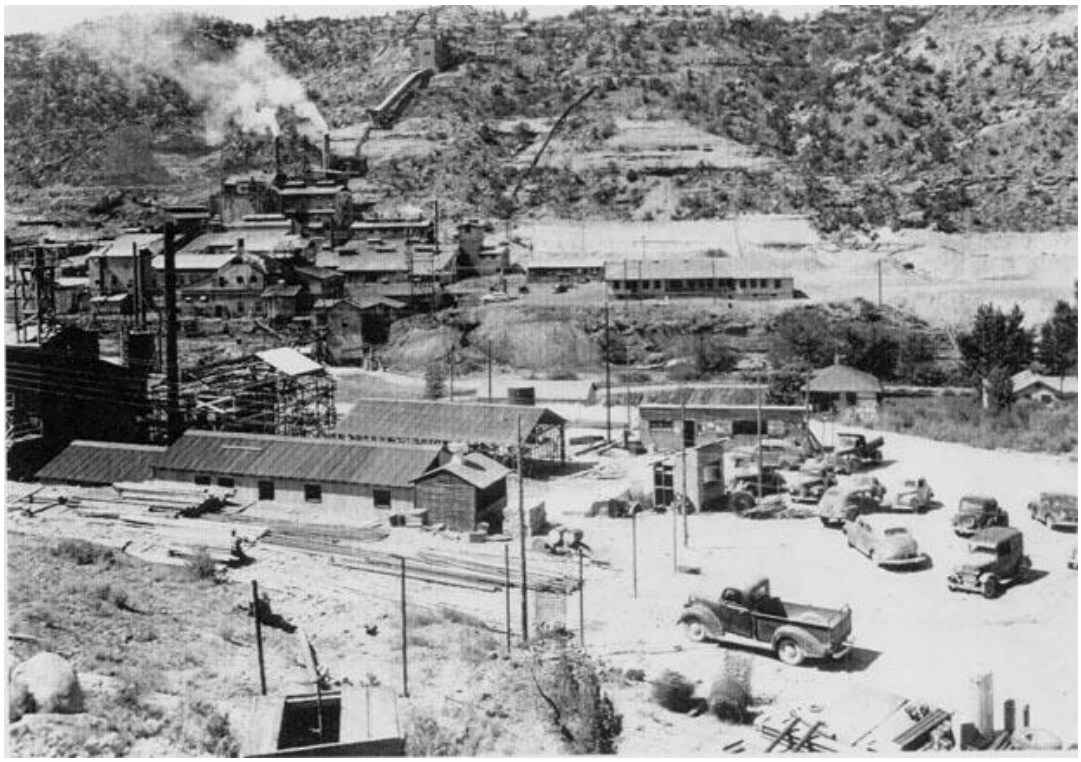

Figure 2.4: Photograph of Uravan showing the Manhattan Engineer District Mill, ca. 1944. This mill processed uranium for the Manhattan Project. Note the fence and guard post. Source: Eastalee Silver Collection, http://www.uravan.com/pictures.asp?category=3&id=17.

Though exact accounts vary, a percentage of the uranium used in the Manhattan Project was mined and milled at Uravan.[130] After the war's end this fact brought no shortage of pride to the small community. Pins and certificates of appreciation were handed out by the Secretary of War to commemorate Uravan employees' role in the Manhattan Project.[131] Newspaper articles touted the role that Colorado played in ending the war, with headlines such as "One of Uranium Ores Dug by Paradox Valley Miners",[132] and "Colorado Vanadium Deposits Yield Uranium,

[130] Alexandroff, "Historic Context of Uravan," 46.
[131] Alexandroff, "Historic Context of Uravan," 35.
[132] "One of Uranium Ores Dug By Paradox Valley Miners," *The Christian Science Monitor*, August 8, 1945.

Vital for the Atomic Bomb".[133] Uravan's role in the war became a source of state-wide and even regional pride as news emerged that Uravan uranium had been "loosed over Japan".[134] Uravan's workers were commonly portrayed as hardworking and industrious. Despite some evidence to the contrary, one news article claimed that "nobody in the Valley got excited over President Truman's announcement, because the valley people don't get excited. They just went right on digging Vanadium".[135]

After World War II Uravan's success slowed. In late 1945 the town was mothballed, the second time the community had been closed down since its founding as a Standard Chemical Company outpost.[136] A news report of the closure was headlined "Atomb Bomb Town to Become Ghost", a prescient title for what was to come.[137] A few people were hired to keep watch over the remaining buildings, but Uravan was largely empty until domestic uranium production was made profitable again in 1947.[138]

The Cold War: Toxicity Catches Up

The Atomic Energy Commission began a peacetime uranium licensing project in 1949, and U.S. Vanadium's mills at Uravan were re-opened.[139] Through the AEC contract the mill was renovated and a full uranium recovery circuit was installed.[140] Uravan was back up and running.

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[133] "Colorado Vanadium Deposits Yield Uranium, Vital for the Atomic Bomb." *The Wall Street Journal, August 8, 1945.*
[134] "One of Uranium Ores Dug By Paradox Valley Miners," *The Christian Science Monitor,* August 8, 1945.
[135] "One of Uranium Ores Dug By Paradox Valley Miners," *The Christian Science Monitor,* August 8, 1945.
[136] Amdunson, *Yellowcake Towns,* 39.
[137] "Atom Bomb Town to Become Ghost," *Metropolitan Pasadena Star-News,* October 14, 1945.
[138] Amdunson, *Yellowcake Towns*, 39.
[139] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 47.
[140] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 47.

The 1950's saw a boom in uranium prospecting and processing as guaranteed prices set by the U.S. government drove up demand. Additional homes were constructed, and teachers taught over 200 children at local schools during the height of Uravan's population.[141] A new plant, called the "B" plant, was built in 1956 to keep Uravan competitive in the rising market.[142] Environmental concerns had largely been ignored in Uravan, but they emerged on U.S. Vanadium's radar in the late 1950's.[143] An effluent and river water monitoring program was finally implemented in 1958.[144] Despite this, the waste water from milling was only treated (or "neutralized") starting in 1967.[145]

Uravan was a bustling place throughout the 1960's. Children played in the local swimming pool, families brought baked casseroles to potlucks at the community center, and the town continued to thrive. Though the installation of telephones and televisions in the 1960's brought outside connections to the small town, the community center remained the central hub of activity.[146] In 1971 everything changed. The U.S. government closed the domestic uranium acquisition program, and by the early 1980's the uranium market had fully collapsed.[147] Uravan operated only six months of the year between 1981 and 1984, and many residents left.[148] The town was officially closed in 1984[149], and the last resident left in 1986.[150]

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[141] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 47.
[142] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 47.
[143] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 48.
[144] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 48.
[145] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 48.
[146] Alexandroff, "Historic Context of Uravan," 19.
[147] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 49.
[148] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 49.
[149] Alexandroff, "Historic Context of Uravan," 20.
[150] Hamrick, Kocis, and Shepard, *Uravan, Colorado*, 50.

As is typical of the communities impacted by uranium mining, experts sometimes suggested that the population of Uravan was too small for longitudinal or other studies to produce any meaningful results.[151] However, evidence of the potential harm from uranium mining and milling had been accruing for years before anything was done.[152] Media reports often focus on "uranium widows",[153] and miners and millers often bore the brunt of health effects. However, the reality is that uranium mining impacts the whole community, not just those who work in the mines or mills.[154] The first official recognition of the potential for an epidemic of cancer among miners came in 1956, when officials autopsied a miner who had died of lung cancer.[155] However, the industry was slow to change, and cancer could take years to develop. Most of the damage had already been done.

It's important to note that direct industrial activity did not pose the only health risk in Uravan. At the end of 1969 the Colorado Health Department discovered that 10 homes in Uravan had been built in the 1920's on old mine tailings piles.[156] Radon levels in seven of them exceeded the levels allowed in uranium mines.[157] Andie and Audie Schmaltz were some of the residents impacted.[158] They'd moved to Uravan 20 years earlier, and had tried to plant a garden, but nothing grew.[159] The pipes in their yard were eaten away by the acidic tailings multiple

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[151] John Boice et al., "Mortality Among Residents of Uravan, Colorado who Lived Near a Uranium Mill, 1936-84," *Journal of Radiological Protection*, 27:3 (October 2007), 299-319, https://www.researchgate.net/publication/6072863_Mortality_among_residents_of_Uravan_Colorado_who_lived_near_a_uranium_mill_1936-84.

[152] "Dear Sir, Your House is Built on Radioactive Tailing Waste," *The New York Times,* October 31, 1971.

[153] Peter Hessler, "The Uranium Widows," *The New Yorker*, September 13, 2010, https://www.newyorker.com/magazine/2010/09/13/the-uranium-widows.

[154] This is seen even more clearly in other communities such as Church Rock, New Mexico.

[155] Peter Hessler, "The Uranium Widows," *The New Yorker*, September 13, 2010, https://www.newyorker.com/magazine/2010/09/13/the-uranium-widows.

[156] "Dear Sir, Your House is Built on Radioactive Tailing Waste," *The New York Times,* October 31, 1971.

[157] "Dear Sir, Your House is Built on Radioactive Tailing Waste," *The New York Times,* October 31, 1971.

[158] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times*, April 12, 1970.

[159] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times,* April 12, 1970.

times, but Union Carbide kept replacing them.[160] In 1970 they were forced to evacuate their home due to the incredibly high radon levels within - as much as 160 to 710 times the maximum allowed.[161] A news article about the tailings problem claimed that "they became the first families in history forced to vacate their own homes due to radon. They will not be the last."[162] It turned out that this statement was very true.

Preparation for Burial: The Remediation of Uravan

The last day of Uravan as a town was December 31st, 1986.[163] Because Uravan was owned in its entirety by what was then called Umetco, the company had complete control over town property, and could require that residents vacate at will. The EPA's Remedial Action Plan required all residents to leave the town before that date.

The production of uranium and vanadium at Uravan left behind over 10 million cubic yards of tailings.[164] Each grain of sandy material contained traces of radioactivity and potential toxicity. After Uravan was shut down, the town was then dismantled and "cleaned up" over a period of approximately 20 years. Legal issues regarding the responsibility of the cleanup were abundant, and the State of Colorado sued Union Carbide and their subsidiary Umetco to require them to fund the site's remediation.[165] Eventually the site became a part of Superfund. (As in

[160] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times*, April 12, 1970.
[161] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times*, April 12, 1970.
[162] "The Trouble with 90.5 Million Tons of Radioactive Tailings," *The Los Angeles Times*, April 12, 1970.
[163] "Final Remedial Investigation Report: Uravan Uranium Project (Union Carbide) Superfund Site Uravan, Colorado," Prepared by CDM Federal Programs Corporation, October 2017, https://semspub.epa.gov/work/08/100001775.pdf. 2-1.
[164] "Final Remedial Investigation Report: Uravan Uranium Project Superfund Site Uravan, Colorado."
[165] "Union Carbide to Clean Up Mining Town in West," *The New York Times*, November 1, 1986, https://www.nytimes.com/1986/11/01/us/union-carbide-to-clean-up-uranium-site-in-west.html.

many cases of nuclear-related contamination, the landscape of legal responsibility and funding is complex.)

To facilitate a staged remediation, the Uravan site was divided into several working areas. The town itself was categorized separately from nearby tailings heaps, which were broken into geographically divided zones. The town of Uravan comprised over 50 mill-related buildings and over 260 town-related buildings, all of which were eventually removed as part of the Remedial Action Plan.[166]

Figure 2.5: The beginning of the demolition of the G Block houses in Uravan, 1985. Source: George Elliott, http://www.uravan.com/pictures.asp?category=6&id=78.

[166] "Final Remedial Investigation Report: Uravan Uranium Project (Union Carbide) Superfund Site Uravan, Colorado," Prepared by CDM Federal Programs Corporation, October 2017, https://semspub.epa.gov/work/08/100001775.pdf. Section 4-1 page 33.

Aside from the impact on human health and the environment, remediation was an extremely expensive process. As noted by James E. Fell and Eric Twitty, the total cost of remediation *likely approached the total value of the minerals ever extracted from Uravan.*[167] Cleaning up the site cost over $120 million dollars. The site processed over ten million tons of ore during its lifetime. Even assuming that each ton of ore produced a ton of saleable material, that would have to mean that each million tons was worth 12 million dollars for Uravan to have simply broken even, not accounting for any of the considerable costs incurred in building a town, sustaining a workforce, and distributing the final product. This also does not factor in the cost to the natural environment or the loss of usable habitable land. Whether it was "worth it" or not is outside of the bounds of this thesis to decide, but it is certainly a relevant point of debate for interpretation of the site to take on in the future.

Preservation Issues

Community Organizing

In 1994 Susie Ludeman, postmaster at the Naturita post office, stamped a letter with a new postmark.[168] *Thhh-wump.* An image of Joe Jr. Boardinghouse, half-faded and awkwardly pressed, adorned the parcel. The oldest building in Uravan was in danger of becoming a ghost, and the commemorative stamp recognized this. The impermanence of the stamp - with its 30-day limited run and inherent temporariness - mirrored the uncertain fate of the wood-frame building. The nearby Naturita post office had issued the commemorative postmark to honor Uravan's

[167] James E. Fell and Eric Twitty, "The Mining Industry in Colorado," National Register of Historic Places Multiple Property Documentation Form, Accessed April 22, 2020, https://www.historycolorado.org/sites/default/files/media/document/2017/651.pdf.
[168] "Naturita Offering Commemorative Postmark," *San Miguel Basin Forum*, August 25, 1994, https://news.google.com/newspapers?nid=1395&dat=19940825&id=ISElAAAAIBAJ&sjid=YREGAAAAIBAJ&pg=524,2764989

presence and demise.[169] The image chosen was a line drawing created by Dorothy Blake, a former Uravan resident who would later be one of many to sue Union Carbide for radiation-related injuries.[170]

The heritage of Uravan continued to be recognized even after the town was vacated for good. On June 17, 1994, former residents gathered for a potluck picnic.[171] Over warm potato salad they discussed the town's demise. The mills that had long marked the town's center had recently been remediated - dismantled, bulldozed into an unrecognizable heap, and set for burial. The homes that they had lived in, decorated, raised families in, were being destroyed. Concerned about their hometown falling to the massive earthmovers, the residents debated which buildings in town might be preserved.[172] Marty Alexandroff had been hired to complete a historic context report for Uravan, and as part of that he conducted a survey of former residents.[173] He asked "if a building could be saved for historical purposes at Uravan, which one(s) would you like to see remain and why?"[174] The boarding house and recreation hall received an "overwhelming" response.[175] 23 out of 25 survey respondents mentioned the recreation hall in their response, and 13 mentioned the boarding house.[176] The community had spoken, and the drive to save the remaining structures was set in motion.

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[169] "Naturita Offering Commemorative Postmark," San Miguel Basin Forum.
[170] United States Court of Appeals Tenth Circuit, Case No. 07-1532, August 21, 2009, https://cases.justia.com/federal/appellate-courts/ca10/07-1532/07-1532-2011-03-14.pdf?ts=1411088337.
[171] Moab Happenings Newsletter, August 2017, Accessed March 2020, https://www.moabhappenings.com/PDF/MoabHappenings201708Aug.pdf. Pg. 16A.
[172] Alexandroff, "Historic Context of Uravan."
[173] Alexandroff, "Historic Context of Uravan."
[174] Moab Happenings Newsletter, August 2017, 16A.
[175] Moab Happenings Newsletter, August 2017, 16A.
[176] Alexandroff, "Historic Context of Uravan." It's worth noting that an additional two respondents answered that "all of the buildings in town should be preserved."

The Rimrocker Historical Society (based in nearby Naturita) worked for years to preserve Uravan's history. In November 1994 the Joe Jr. Mill and Camp, including the boarding house and recreation hall, was nominated to the Colorado State Register of Historic Places.[177] This process requires owner consent, so it can be inferred that Union Carbide[178] was supportive of the listing.[179] The Rimrocker Historical Society hoped to turn the two buildings into a museum about Uravan's history, and the state listing was the first step in this plan. A year later, in July 1995, the Uravan Historic District was determined to be eligible for the National Register of Historic Places. This eligibility came under National Register Criterion C, as Uravan "represented the history of radium, vanadium, and uranium mining in Colorado, and made a significant contribution to the Manhattan Project during World War II."[180] At the time of the determination of eligibility, there were three buildings left standing in Uravan, each with contributing status: the boarding house, the recreation hall, and the Uravan Drug Store. The SHPO acknowledged that the history of Uravan would have to be told through the last three remaining buildings, since the rest of the down had already been demolished without prior approval or review.[181] They advised Umetco to develop a plan to preserve them.[182] In an in-person meeting Umetco agreed to save the boarding house and recreation hall, but their decision about the drug store "was not documented".[183] Two months later the Uravan Drug Store was demolished by Umetco

[177] It was later delisted on Dec 31, 2007. History Colorado, "Joe Jr. Mill and Camp," accessed March 2020, https://www.historycolorado.org/location/joe-jr-mill-and-camp.
[178] Or whatever entity owned the property at that point - the legal issues are complex.
[179] Office of Archeology and Historic Preservation, "Information on Nominating Properties to the National Register of Historic Places and the Colorado State Register of Historic Properties," accessed March 2020, https://www.historycolorado.org/sites/default/files/media/document/2017/1501.pdf
[180] United States Environmental Protection Agency, "Final Five Year Review, Uravan Umetco Minerals Corporation Uravan Superfund Site," March 13, 2000, Accessed March 2020, https://semspub.epa.gov/work/08/482693.pdf, 178.
[181] US EPA, "Final Five Year Review," 178.
[182] US EPA, "Final Five Year Review," 178.
[183] US EPA, "Final Five Year Review," 179.

contractors without warning.[184] Aside from the virtually inevitable deconstruction of many of the town's highly contaminated residential and industrial buildings, this demolition was Uravan's first major preservation loss.

Figure 2.6: The Uravan Drug Store, ca. 1935. Source: Kenneth Bonner, http://www.uravan.com/pictures.asp?category=11&id=23.

Section 106 Involvement

The Section 106 process exists to protect historic resources from unreviewed demolition, but it did not play out at Uravan in the way intended. Remediation in Uravan began in the late 1980's, but the Colorado SHPO was unaware of the remediation activities happening on site until June 1995, when a SHPO officer made a site visit to check on work funded by the State Historic Fund.[185] This fits with the study completed in 1999 by Fredrick Quivik, in which the Colorado SHPO reported that the EPA had a "spotty" Section 106 compliance record, attributed

[184] US EPA, "Final Five Year Review," 179.
[185] US EPA, "Final Five Year Review," 178-179.

largely to "a lack of awareness on the part of individual Superfund project managers with EPA's Section 106 obligations."[186] In a startling oversight, neither the Remedial Action Plan or the Final Consent Decree of 1986 even mentioned Section 106 of the National Historic Preservation Act, and this seems to have led the project heads to assume they had no legal obligation to comply with it.[187] As a result, remediation was carried out under the terms of the RAP, which stipulated that alternatives to demolition could only be provided for if the building or equipment were to pass the "free release criteria" for radioactive contaminated materials, i.e., those that were not contaminated to begin with.[188]

Even after the SHPO became involved, mishaps continued to happen. The SHPO was not informed of the pending Uravan Drug Store demolition, and a letter documenting the SHPO's meeting with Umetco did not spell out the requirement that the building had to be preserved.[189] As a result, the demolition took place before SHPO representatives could document the building through photographic or other means. By fall 1995 only the boarding house and community hall remained intact. Umetco agreed to preserve them in 1997, only to backtrack in 1998 over concerns regarding the legal liability incurred in leaving the buildings intact with trace amounts of contamination.[190] They eventually yielded to the EPA's recommendations that they follow the SHPO's advice, and the two buildings were evaluated for future restoration work.

As noted in a 1999 report, the EPA remained fully on board with the plan to preserve the buildings for future interpretive use.[191] In a table entitled "Summary of Factors Affecting

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[186] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Superfund's Record," 55.
[187] US EPA, "Final Five Year Review," 178-179.
[188] US EPA, "Final Five Year Review," 179.
[189] US EPA, "Final Five Year Review," 179-180.
[190] US EPA, "Final Five Year Review," 180.
[191] Umetco Minerals Corporation, "Site-Specific Soil Cleanup Objectives Rationale Document for Uravan Project, Colorado," June 1999, accessed March 2020,

Ultimate Land Fate for Uravan Project Areas", the report proposes that ownership of the historic properties be transferred to a semi-public organization such as the Rimrocker Historical Society or the state parks system.[192] However, in a hint of the complexity associated with remediation and historic buildings, the report notes that "Evaluation of the historic structures is not within the scope of this document because of the unique aspects regarding the preservation of these buildings".[193]

Restoration and Future Plans

The buildings underwent a careful restoration in the year 2000.[194] Based on photos of the restoration process, the boarding house saw the reconstruction of an upper level porch as well as several other structural fixes.[195] Boarded up window and door openings on the second floor were re-opened, and exterior fire stairs and landings were repaired or replaced. Wide stairs were added to the front of the lower porch, presumably to make public access easier for the building's planned use as a museum. The recreation hall was spruced up with new roof cladding.[196]

Work on the buildings was completed in part with a $97,700 grant from the State Historical Fund.[197] (Umetco also provided a similar amount of funding.)[198] Colorado State Historical Fund monies are generated by state gaming tax revenues and distributed to historic property owners through a competitive grant system. Currently, all properties that receive grant money for physical work through the fund are required to provide for the physical protection of

https://semspub.epa.gov/work/08/1888140.pdf

[192] Umetco Minerals Corporation, "Site-Specific Soil Cleanup Objectives," 20.
[193] Umetco Minerals Corporation, "Site-Specific Soil Cleanup Objectives," 2.
[194] Photos posted on Uravan.com, http://www.uravan.com/pictures.asp.
[195] Photos posted on Uravan.com, http://www.uravan.com/pictures.asp.
[196] *Guide to Colorado Historic Sites,* 2006, 368.
[197] *Guide to Colorado Historic Sites,* 2006, 368.
[198] Alexandroff, "Historic Context of Uravan."

the property for a set period of time.[199] Grants in excess of $50,001 but less than $100,000 typically have to have a 20-year covenant written into the land deed.[200] It is not clear if these restrictions were in place when funding was acquired for the Uravan buildings, or if such a covenant was ever obtained. (Covenants have to be filed with the county in which the building resides, but property records for Uravan are no longer available through the Montrose County Assessor's office.) However, the land title holdings of Superfund properties are extremely complex, and it may have been difficult to apply a legally binding covenant to the current owner (Union Carbide/Umetco). If these protections were in place at the time, they were not enough to save the buildings from demolition.

In 2001 the Rimrock Historical Society and the Umetco Mineral Corporation won a Stephen H. Hart Award for their preservation efforts in restoring the Joe Jr. Boarding house.[201] The award is presented in recognition of outstanding projects and individual achievements in archaeology and historic preservation throughout the state of Colorado.[202] Umetco advertised the prize as a win for community engagement during the remediation process. The members of the Rimrock Historical Society were encouraged to keep going.

In 2004 the EPA issued a partial deletion of 9.84 acres, including the two historic structures, from the National Priorities list.[203] By the EPA's standards, that section of Uravan had been cleaned up. Soil had been removed from around the boarding house and recreation hall, but

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[199] History Colorado Publication, accessed March 2020. https://www.historycolorado.org/sites/default/files/media/document/2019/1412.pdf

[200] History Colorado Publication, accessed March 2020. https://www.historycolorado.org/sites/default/files/media/document/2019/1412.pdf

[201] History Colorado, "Stephen H. Hart Awards for Historic Preservation 2000-2013," accessed March 2020, https://www.historycolorado.org/stephen-h-hart-awards-historic-preservation-2000-2013

[202] History Colorado, "Stephen H. Hart Awards for Historic Preservation."

[203] "Final Remedial Investigation Report: Uravan Uranium Project (Union Carbide) Superfund Site Uravan, Colorado." Prepared by CDM Federal Programs Corporation, October 2017. https://semspub.epa.gov/work/08/100001775.pdf.

the buildings had emerged from remediation as-yet unscathed. The plan was to keep the building as-is, and then transfer stewardship of them to the Rimrock Historical Society. A 2006 *Guide to Colorado Historic Sites* featured the remnants of the Joe Jr. Camp, saying "The surviving boarding house and recreation hall commemorate a now-gone industry that once made western Colorado a national hot spot...these two structures are the last survivors of a once thriving camp that was one of the earliest and most important ore-processing centers of America's nuclear age."[204] The use of past-tense is particularly interesting in this passage, for uranium mining is very much present, and America's nuclear age is far from over. For Uravan, however, the past tense was probably even more appropriate than the author could have known.

Few EPA documents remain publicly accessible from the time between late 2004 and early 2007, so the ways in which the remediation plan evolved based on data can only be inferred by examining other evidence. There is little written about the lead-up to the decision to demolish the buildings. In fact, most evidence seems to suggest that the decision was made hastily, with little warning. A news article from a few days after the fire claims that the Colorado Historical Society had been consulted prior to the burning, and that they had determined that they'd already obtained enough photographs and dimensions to "keep record".[205] Rahe Junge, Umetco's remediation manager, was quoted as saying "My understanding is that the buildings were beyond the point of being salvageable", which is, perhaps, a convenient way of qualifying such a statement.[206] However, it is worth noting that the same article reports that the buildings were "not part of the National Register of Historic Places", even though they were deemed eligible for

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[204] *Guide to Colorado Historic Sites*, 2006, 368.

[205] Robert Allen, "Historic Uravan Buildings Go Up in Smoke," *Montrose Press*, February 16, 2007, https://www.montrosepress.com/news/historic-uravan-buildings-go-up-in-smoke/article_1ded55b7-bf89-570e-a19f-927aad111f87.html.

[206] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."

listing in 1995.[207] This distinction is vague, but important. Setting the buildings outside the realm of authorized discourse by claiming that they were not part of the National Register seems to be aimed at convincing citizens that these buildings were not historically significant, and, therefore, not worth preserving. The implication is that the destruction by fire of Uravan's earliest structures was, therefore, no great loss. If the buildings were not valued, they might not be missed.

If the Colorado SHPO was, in fact, consulted prior to the demolition, their response is not part of the public record. The Joe Jr. Mill and Camp site was delisted from the Colorado State Register of Historic Places several months later, on Dec 31, 2007.[208] Moving the structures was apparently considered, but they were deemed too unstable to transport. It is unknown whether an experienced preservation engineer was engaged in that decision making process, though references to a general contractor suggest that it is unlikely that an expert was consulted for the job.[209] Demolishing the buildings with a bulldozer was also thought of, but placing wood buildings at the top of an already-full waste pile, near the cap, could pose problems down the line.[210] Wood could rot, expand, and shift.[211] The cap could come loose.[212] Instead, fire was suggested as a reasonable alternative.

Uravan Turns to Ash

February 13th, 2007 was a cold end-of-winter day. Snow had fallen the night before, and patches of ice clung to the roof of the workers' white Ford pickup as they pulled off of Highway

[207] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."
[208] History Colorado, "Joe Jr. Mill and Camp," accessed March 2020, https://www.historycolorado.org/location/joe-jr-mill-and-camp.
[209] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."
[210] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."
[211] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."
[212] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."

141. Bits of snow continued to fall as they donned neon orange vests over their wax-coated jackets. They hopped down from the truck and grabbed the necessary supplies, and in the early morning light they set the last buildings of Uravan ablaze.

Figure 2.7: Umetco workers set the fire at the boarding house. Source: "Fire at Rec Hall and Boarding House #1". Source: Photographed by Kenneth Bonner, February 13, 2007. http://www.uravan.com/pictures.asp?category=8&id=163.

Diesel was spread on parched timbers from red plastic cans.[213] It did not take long for the wood to catch. Someone with a radiation meter stood a safe difference away. And the last of Uravan burned. First the floorboards, then the roof. Wood beams hauled in by pack burro a hundred years before; planks hewn at far-off sawmills; front porch stairs where miners used to stomp the tawny-colored dust off of their boots; it all became fuel for a short-lived blaze. A few remaining townspeople stood witness as the last remnants of the town they grew up in became a

[213] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."

heap of 5,000 cubic yards of charred debris. Uravan's last-minute funeral pyre was over in the blink of an eye.

But there is a cruel irony in the fact that the two buildings most important to Uravan's history (and its residents) were the only two left without a permanent physical presence. The few charred bones of the building were taken nearby for disposal. But these last buildings were not granted the afterlife afforded to their less-significant counterparts. The least the contractors could have done, it seems, was bury Uravan whole, a massive heap of jumbled buildings, framing members crossing like pick-up-sticks in a pile, radioactive isotopes decaying for near-eternity. A mountain for future civilizations to find. Instead, the community hall and boarding house, cleaned of contamination, received a separate funeral, an internment in a different place. They were the last buildings to vanish.

Figure 2.8: The last of Uravan's buildings burn. Source: "Fire at Rec Hall and Boarding House #2". Photographed by Kenneth Bonner, February 13, 2007. http://www.uravan.com/pictures.asp?category=8&id=167.

The reasons commonly cited as justification for the demolition-by-fire were structural issues, the presence of black mold, and the potential liability of Union Carbide in leaving any

remaining structures.[214] Legal issues aside, the conservation issues of the two buildings fail to make a compelling case for the treatment they received. Black mold can have negative health impacts, but it is possible to remove it while leaving the majority of historic fabric intact. Certainly, were black mold to befall a historic building such as Monticello, few people would argue for taking the "kill it with fire"[215] approach. Structural issues can also be quite serious, but might have been possible to fix. Beams can be added to wood-frame buildings, even fragile ones, to shore up the structure. Structural issues have been solved at much more complex buildings than the diminutive wood-frame halls of Uravan. Climate conditions are also generally favorable - Uravan received an average of a scant 12.5 inches of rainfall a year between 1960 and 2014.[216]

A quote from Marty Warner posted on the Uravan.com website illustrates some of the rationale offered for why the buildings were burned.

> "The boarding house was in such bad shape, when you walked across the upstairs floor the downstairs ceiling would sag and the walls would bend inward. That wasn't the worst part, the mold inside the walls was that "black mold" which would call for more remediation. Umetco had already put nearly $1 million in remediation of both buildings, and working around them. There were so many liability issues in the turning over of the buildings that would have been an enormous burden to Montrose County--it just didn't make sense, financially or otherwise. The building wouldn't have survived being moved, and it had to leave the property. The NRC will take possession of the property eventually, and they have stipulations that prevent any structures being left. But since they burned, there's hardly a picture of Uravan that doesn't have the boarding house in it, which makes me sad that it couldn't be salvaged. I had a chance to go into the rec hall as well, and it was a very interesting structure. So there are no more buildings left here. They just spent over half a million on reseeding the valley floor, so that should look nice in the spring."
>
> -- Marty Warner, 2007, comment on photos posted on Uravan.com, http://uravan.com/pictures.asp?category=8&id=163.

[214] Robert Allen, "Historic Uravan Buildings Go Up in Smoke."

[215] The images of Uravan burning really do call back a certain internet meme often deployed in reference to spiders. Fittingly, an internet meme said to be directly related to the "kill it with fire" meme is "nuke it from orbit". (https://knowyourmeme.com/memes/kill-it-with-fire)

[216] "Final Remedial Investigation Report: Uravan Uranium Project (Union Carbide) Superfund Site Uravan, Colorado," Prepared by CDM Federal Programs Corporation, October 2017, https://semspub.epa.gov/work/08/100001775.pdf. Pg. 2-3

Current Site Status: Markings, Memory, and Interpretation

The town of Uravan has now been completely demolished. The only spatial presence of the town is delineated by a historic flagpole from the post office, and the low piles of strange rocks. The Rimrock Historical Society has been able to lease the ballpark area near the remediated zone, and they still hold annual picnics to commemorate the passage of the town as well as the dispersal, and reunification, of former residents. Few people driving by would know to stop to view the small historic marker planted something short of triumphantly in the sandy soil.

Perhaps, though, the very absence of Uravan has a presence more potent than the two historic buildings that might have been saved. The fact that an entire town was carefully swiped down from the face of the earth into a gaping hole - that this destruction was purposeful, calculated - makes it all the more interesting to onlookers. The absence is an anomaly, a curiosity. In some ways, the destruction of Uravan can be seen as a warning. But this will only translate to future generations if we remember what happened there. In a few generations the light grey stones may look like just another half-finished construction project, and tourists may motor past without spotting the low stone marker. They may not question why a solitary flag flies in the middle of the desert. This is the danger of leaving Uravan buried - if the tomb is not grand enough then it is possible that no one will visit.

For now, Uravan continues to be kept alive and in the public memory through a tradition of annual picnics. Once remediation was declared complete, former residents celebrated with a yellow sheet cake, a reference to the yellowcake uranium produced at Uravan. All those who once called Uravan home were invited. But the population of former Uravanites is dwindling with the passing of time. Families have spread out. Those who once played in Uravan’s towering

tailings heaps as children have moved to places where black and yellow trefoils do not dance across the landscape in the glare of oncoming headlights. Estimates of the town's population at the height of nuclear production vary, but it was likely around 800.[217] As former residents continue to disperse, the numbers of those who remain may not be enough to keep broader public memory alive. Though some stories and oral histories have been collected on a website dedicated to facilitate former community members reminiscing about the town, the real tragedy of Uravan may be that it could become almost completely forgotten.[218]

The history of Uravan does not go entirely uninterpreted. The local Rimrocker Historical Society museum has exhibits about the history of the local area, Uravan included. Located in nearby Nucla, the museum operates out of the historic Vesta house.[219] The museum is largely filled with historical artifacts donated by local residents.[220] Their website, which provides an overview of local history, notes that:

> The town of Uravan sprang up overnight as a headquarters for this (mining) industry, supporting the top-secret Manhattan Project. But by 1984 the industry had played out. Uravan became a superfund site and was dismantled, shredded, and buried. Only memories remain.[221]

The Rimrocker Historical Society also publishes a newsletter, which frequently mentions the burning of the last two Uravan buildings.

> After years of negotiations and grant seeking, winning a prestigious award for their efforts to preserve these two buildings, RHS watched their dream of a Uravan memorial torched by Dow Chemical Co "for liability reasons".[222]

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[217] Peter Hessler, "The Uranium Widows," *The New Yorker*, September 13, 2010, https://www.newyorker.com/magazine/2010/09/13/the-uranium-widows.
[218] http://www.uravan.com/comments.htm.
[219] Rimrocker Historical Society, "About Rimrocker Historical Society," last updated 2016, accessed February 2020, https://www.rimrocker.org/about.
[220] Rimrocker Historical Society, "Museum," last updated 2016, accessed February 2020, https://www.rimrocker.org/museum.
[221] Rimrocker Historical Society, "Museum."
[222] Rimrocker Historical Society Annual Newsletter, January 2018, http://www.sjbas.org/RHS%20Newsletter%202018.pdf.

This suggests that this aspect of the remediation process, at least, will not be readily forgotten by RHS members.

Figure 2.9: The Rimrocker Museum in Nucla, CO. Source: https://www.rimrocker.org/museum.

In Grand Junction, Colorado, about 90 miles away, the recently opened Atomic Legacy Cabin also partially stands in for the lost built environment of Uravan. The Atomic Legacy Cabin was opened on June 6th, 2019, and its aim is to serve as the interpretive center for "the history of uranium on the Colorado Plateau as well as Grand Junction's unique contribution to the Manhattan Project, the Cold War, environmental cleanup, and the U.S. Department of Energy's continuing legacy management".[223]

The cabin's website advertises that:

> Visitors can learn why the area's geology is rich in uranium ore, how that ore helped end World War II, and what fueled the frenzy of Grand Junction's "uranium boom" during the Cold War. Exhibits detail the nation's largest mill tailings cleanup and remediation

[223] United States Department of Energy Department of Legacy Management, "Grand Junction Site Atomic Legacy Cabin," last updated March 17, 2020, accessed February 2020. https://www.lm.doe.gov/Grand_Junction/ALC/ALC.pdf.

project, as well as current work by the U.S. Department of Energy Office of Legacy Management to protect human health and environment. Visitors can also view a collection of artifacts from the historic Grand Junction office site, and other items unique to the area's local history.[224]

Figure 2.10: The Atomic Legacy Cabin. Source: United States Department of Energy, "Grand Junction Site Atomic Legacy Cabin," https://www.lm.doe.gov/Grand_Junction/ALC/ALC.pdf.

However, the story of Uravan is only one of many presented at the Atomic Legacy Cabin, and it seems to have a limited presence in the small museum. While it is difficult to critique the interpretation of Uravan without being able to see the exhibits themselves (photos of the Uravan specific exhibit do not seem to have been posted online), published text for the museum offers some insights into how the museum may be conceptualized. The line in the website's description

[224] United States Department of Energy Department of Legacy Management, "Explore the Atomic Legacy Cabin," accessed February 2020, https://www.energy.gov/lm/explore-atomic-legacy-cabin.

that visitors can learn how "ore helped end World War II"[225] suggests that the tone of the museum may be focused on a more patriotic (and potentially less critical) view of that particular history. Debates about the United States' role in the end of World War II are outside of the purview of this thesis, but that detail does suggest that the museum may focus more on the products of uranium ore extraction, rather than the negative impacts. Furthermore, while the blurb does suggest that the remediation is discussed, it is likely that that discussion centers on the Department of Energy's role in the remediation given the context. Placing the site at the DOE headquarters also ensures that only certain narratives will be represented. To some (including to some members of indigenous communities), the DOE site may be considered enemy ground.[226] Regardless, the site is fenced, controlled, highly organized, clean. This does not necessarily reflect the realities of uranium mining or milling.

The preservation choices undertaken in the restoration of the cabin, which are also quite interesting. Intentionally or not, the building, which dates to 1943,[227] has been scrubbed clean to the point that it no longer looks old. The cabin was originally built as the headquarters of the Manhattan Engineer District - the arm in charge of obtaining mined uranium for the Manhattan Project.[228] It later became a headquarters for the Atomic Energy Commission.[229] The wood is freshly stained, the fawny orange color found on new lumber at a hardware store. The patina is missing. The blacktop parking lot does nothing to enhance the ambiance of the space. If

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[225] US DOE Department of Legacy Management, "Grand Junction Site Atomic Legacy Cabin."

[226] Aside from obvious and varied problematic histories carried out by the AEC over the years, they also studied the health impacts of uranium mining on miners without their knowledge for years. Keith Schneider, "Uranium Miners Inherit Dispute's Sad Legacy," *The New York Times*, January 9, 1990, https://www.nytimes.com/1990/01/09/us/uranium-miners-inherit-dispute-s-sad-legacy.html.

[227] United States Department of Energy Department of Legacy Management, "Preservationists Tour Historic Log Cabin at the Grand Junction, Colorado, Office," April 19, 2016, accessed February 2020, https://www.energy.gov/lm/articles/preservationists-tour-historic-log-cabin-grand-junction-colorado-office.

[228] US DOE Department of Legacy Management, "Preservationists Tour Historic Log Cabin."

[229] US DOE Department of Legacy Management, "Preservationists Tour Historic Log Cabin."

anything, the parking lot shows what is not there. The expanse of paving compels visitors to not interrogate too closely that which is held beneath the ground. It is as if, in some small way, the issue of nature is resolved. Here there is no sandy soil ripe with cast-off tailings. The environment is sanitized, scientific, danger-free. The history of Uravan has been reclaimed, reasserted, and remade through the process of creating a new museum miles away. This is the territory of the people who control America's nuclear waste sites for an eternity. This is a place where history is confined to a single, small, impermanent structure. The cabin is, for lack of a better word, cute, with all that entails. A single day's worth of dirt from Uravan's mill would swallow it whole. The scale of contamination and destruction, like most everything else about Uravan, is difficult to interpret at a distance.

The Atomic Heritage Cabin also brings up issues of heritage mobility. In some cases it is not possible to leave a building (or an associated history) where it stands. While in this case most of the physical remnants of the town were buried right near where the town had sat, in other cases this heritage has been spread far and wide as part of the remediation process. Hidden in the EPA reports is the fact that some of the high-level waste was hand-collected from Uravan and taken to the Energy Solutions waste dump in Clive, Utah.[230] This for-profit nuclear waste dump serves as the final resting place of much of the material taken from the sites discussed in this thesis as case studies. Asbestos containing materials were also hauled off site to an unspecified location. These materials are still hazardous, and will be for decades to come. Yet their relationship to place has been profoundly altered. New places now serve as repositories for the remnants of historic structures brought from a multiplicity of locales.

[230] "Final Five Year Review, Uravan Umetco Minerals Corporation Uravan Superfund Site." United States Environmental Protection Agency. March 13, 2000. Accessed March 2020. https://semspub.epa.gov/work/08/482693.pdf.

The Uravan site is not entirely abandoned. Visitors can choose to camp or hike nearby, and recent reports of large-scale gold mining highlighted the fact that human occupation of the area is far from over.[231] But the likelihood that a museum on the site created by former residents will come to pass will continue to wane with the passing of years.

Conclusion

As discussed in this chapter, Uravan, Colorado had an important history as a mining company town throughout the 20th century. The battle to preserve the last two Uravan buildings illustrates the many challenges associated with preservation in similar situations. The town of Uravan's remediation process and eventual destruction can also provide lessons in how preservation can intersect with issues of environmental cleanup at radiologically contaminated sites.

[231] Katharhynn Heidelberg, " Montrose County Shuts Down Mechanized Streambed Mining in the San Miguel River near Uravan," May 12, 2019, https://coyotegulch.blog/2019/05/12/montrose-county-shuts-down-mechanized-streamed-mining-in-the-san-miguel-river-near-uravan/.

Chapter 2: New Jersey Radium: Montclair, West Orange, and Glen Ridge, New Jersey

Overview

It is the lawns of Montclair New Jersey that are, perhaps, its most important feature. They stretch in rectilinear patches across plots with 1920's homes dotted with deciduous trees. The vast lawn of College park is set in the midst of this tightly woven street grid.[232] Children's playground equipment frames the eastern edge; shiny black bollards with silver banding sprout like metal asparagus. A grey wire fence with chained padlock does nothing to create a welcoming appearance, but a dark history has already played out on this site. This is where the original United States Radium Corporation building was once located. In the last four decades this land has been torn up again and again to unearth the poison once buried below. Google earth images taken from a satellite show the park as a sort of sandbox, green grass nowhere to be seen, trucks that look like children's miniatures from space digging and rearranging yellowed piles of clean earth. But not all of the physical remnants of the U.S. Radium building ended up here. Tons of radioactive tailings were dumped offsite and used as fill as new residential neighborhoods were constructed. Like the radium girls before them, the houses built here took the company's radium into their bones.

[232] City of Orange Township City Council, "Grand Opening of College Park," accessed February 2020, https://orangetwpnjcc.org/2019/03/grand-opening-college-park/.

Figure 3.1: The former site of the U.S. Radium Co. in Orange, New Jersey. The site is now a park, and is covered in turf. Source: Google Earth.

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This chapter will discuss the history of radium production at Orange, New Jersey, the ways in which environmental remediation was carried out and its impact on the historic built environment, and the current conditions of the site. Preservation outcomes and issues will be summarized and analyzed briefly at the end of the chapter. A full analysis of preservation outcomes at each of the sites is included in the analysis chapter towards the end of this thesis. Like many Superfund areas, the bureaucratic geography of Orange, New Jersey is complex. The contamination from the plant was spread so widely that by the early 2000's it encompassed three

separate Superfund sites, each with multiple operable units within them. These three sites include the U.S. Radium Corp. site, the Glen Ridge Radium site, and the Montclair/West Orange Radium site.[233]

History

The Radium Luminous Material Corporation operated the Orange, New Jersey site from 1917 to 1926.[234] Though its tenure was short, the company's impact on human health and the environment was not. The plant is now famous as the place where some of the radium girls worked. (The radium girls were young women hired to paint watch dials in plants across the country, who later succumbed to a variety of ailments caused by radium poisoning, leading to one of the seminal workers' rights cases of the first half of the 20th century.[235]) However, the plant also produced radium itself from carnotite ore hauled in from, among other places, the Paradox Valley of Colorado, near where the town of Uravan was located.[236] The Radium Luminous Materials Corporation was in direct competition with Joseph Flannery's Standard Chemical Company that operated Uravan, but both corporations were highly profitable during the first quarter of the 20th century.[237] Radium Luminous Materials (the parent company of U.S. Radium Corporation)[238] procured their carnotite ore from a mine near Placerville, Colorado, within 60 miles or so of the Uravan empire.[239]

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[233] United States Environmental Protection Agency, "Record of Decision for the Operable Unit 3 of the U.S. Radium Corporation Site, Essex County, New Jersey," September 27, 2006, accessed February 2020, https://semspub.epa.gov/work/02/95838.pdf, 2.
[234] "Historic American Engineering Record: US Radium Corporation," HAER No. NJ-121, http://lcweb2.loc.gov/master/pnp/habshaer/nj/nj1600/nj1643/data/nj1643data.pdf 77.
[235] Arlene Ballansky, "Radium Girls: Living Dead Women," March 19, 2019, https://blogs.loc.gov/headlinesandheroes/2019/03/radium-girls-living-dead-women/.
[236] "Historic American Engineering Record: US Radium Corporation," 20.
[237] "Historic American Engineering Record: US Radium Corporation," 16.
[238] Not to be confused with U.S. Vanadium Co., which took over operations at Uravan beginning in 1935.
[239] New Jersey Department of Environmental Protection, "Investigation of a Former Radium Processing Site," December 1980, accessed May 4 2020, https://semspub.epa.gov/work/02/55249.pdf, 6.

The Radium Luminous Materials Corporation was founded in 1915 by Dr. Sabin von Sochocky and Dr. George S. Willis.[240] The company's offices were originally located at the Liberty Tower, an office building at 55 Liberty Street in New York City.[241] The corporation underwent many name changes,[242] so some of the company's history remains difficult to track. However, between 1915 and 1917 the company established several extraction and production plants in Newark, Jersey City, and Orange, New Jersey, including the site at Alden and High Streets.[243]

The Radium Luminous Materials Corporation produced radium from carnotite ore. They were known for developing "Undark" radium paint, which was used to impart a glow to dials of all sorts, including watches and grandfather clocks.[244] During World War I the Radium Luminous Materials Corporation held numerous contracts to supply the military with luminous or "glow-in-the-dark" instrument dials, gun sights, and Army-issue luminous field watches,[245] all of which made it possible for soldiers to read crucial information without the use of a lamp - a major innovation at the time. In 1921 the plant was renamed the U.S. Radium Company.[246]

[240] "Historic American Engineering Record: US Radium Corporation," 19.
[241] "Historic American Engineering Record: US Radium Corporation," 19.
[242] "Historic American Engineering Record: US Radium Corporation," 19.
[243] "Historic American Engineering Record: US Radium Corporation," 19.
[244] "Historic American Engineering Record: US Radium Corporation," 21.
[245] "Historic American Engineering Record: US Radium Corporation," 21.
[246] "Historic American Engineering Record: US Radium Corporation," 77.

Figure 3.2: An advertisement for Undark radium paint, ca. 1921. Source: Wikimedia Commons.

It was here, on Alden Street (and in similar shops around the country) that young women, the so-called radium girls, were hired to paint the dials with radium-laced paint. The brushwork required was extremely delicate, and the brushes were only a few camel hairs thick, so the workers were instructed to place the brushes in their mouths to create a fine tip. Each time they did so they ingested a small amount of radium.

In the early years of radium dial production the health effects of radium were not widely understood, and radium was actively marketed as a health-giving substance that could cure all ailments.[247] However, exposure to radium proved to have myriad negative health effects, many of them fatal.[248] The young women in the plant began to fall ill with untreatable ailments (including "Radium Jaw") at alarming rates.[249] Once evidence began to emerge that suggested that their paint was dangerous, U.S. Radium worked to cover it up, and failed to make significant changes to their workplace practices.[250] By the late 1920's many of the radium girls had perished, but the survivors fought valiantly for better workplace protection. Five former New Jersey dial painters who had been sickened by radium poisoning sued the company in 1927, and the case was settled out of court.[251] The story of the radium girls has had long-reaching consequences for U.S. labor and safety laws, making the places where they worked especially historically significant. It has been argued that many of the safety provisions put in place during the Manhattan Project were based on the radium girls' experiences.[252]

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[247] Arlene Ballansky, "Radium Girls: Living Dead Women," March 19, 2019, https://blogs.loc.gov/headlinesandheroes/2019/03/radium-girls-living-dead-women/
[248] Arlene Ballansky, "Radium Girls: Living Dead Women."
[249] Arlene Ballansky, "Radium Girls: Living Dead Women."
[250] Arlene Ballansky, "Radium Girls: Living Dead Women."
[251] Arlene Ballansky, "Radium Girls: Living Dead Women."
[252] "Historic American Engineering Record: US Radium Corporation," 1. Also see Atomic Heritage Foundation page on the radium girls at https://www.atomicheritage.org/history/radium-girls.

Radium companies of the time needed enormous amounts of ore to extract a small amount of usable radium. Approximately a half-ton to two tons of carnotite ore was processed at the New Jersey plant each day,[253] leaving behind mountains of radioactive tailings that were disposed of in the surrounding landscape. Tailings were spread as fill beneath the foundations of houses, sidewalks were filled with the sandy material, and parks were built atop contaminated mounds. Evidence uncovered during the excavation process also reveals that some of U.S. Radium's own buildings were also demolished (likely in the late 1920's) and used as fill beneath houses, thereby reincarnating the industrial threat of radiation as a domestic beast.[254]

Rediscovery and Remediation

The story of the radium girls has been well chronicled, but the history of radiological contamination that infiltrated the town at large (as well as other towns with similar histories) is not as well known. In 1981 an EPA helicopter survey of New Jersey revealed that several areas had radiation levels that were significantly higher than background.[255] The contamination was not publicly revealed until 1983.[256] In total more than 220,000 cubic yards of contaminated soil were spread across 210 acres at an average depth of between five and fifteen feet.[257] [258] The

[253] United States Environmental Protection Agency, "U.S. Radium Corp. Orange, NJ Cleanup Activities," accessed February 2020, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0200772#bkground.
[254] "Historic American Engineering Record: US Radium Corporation."
[255] United States Environmental Protection Agency, "Montclair/West Orange Radium Site Montclair/West Orange, NJ Cleanup Activities," accessed February 2020, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0200997.
[256] US EPA, "Glen Ridge Radium Site Glen Ridge, NJ Cleanup Activities."
[257] US EPA, "Glen Ridge Radium Site Glen Ridge, NJ Cleanup Activities."
[258] "Historic American Engineering Record: US Radium Corporation," HAER No. NJ-121, http://lcweb2.loc.gov/master/pnp/habshaer/nj/nj1600/nj1643/data/nj1643data.pdf, 77.

radium contamination largely impacted single-family homes, many of which had been constructed on top of fill in the intervening decades after the plant had closed.[259]

The scattered and seemingly random geographical distribution of the material across the landscape also made it easier to hide. Like the contaminated tailings themselves, the radon seeping silently into residential basements was invisible, odorless, and undetectable without specialized equipment. By the time the full extent of the contamination was uncovered, hundreds of homes had been dealing with potentially harmful levels of radon gas for decades.

Buildings built with leftover radioactive tailings materials or constructed on top of dump areas were sorted into three classifications based on radon and gamma radiation levels by the EPA.[260] Those with the greatest risk to their occupants were remediated first. Emergency treatment measures varied by property, but in many cases basement ventilation systems were installed to reduce indoor levels of radon gas. In other houses ¼" thick lead sheeting was nailed over basement floors and walls in an attempt to shield homeowners from the gamma radiation emitted from below.[261] Houses in the neighborhood were armored for battle with an invisible enemy, but the real trouble came when it was time to excavate the contaminated materials from below.

One notable aspect of the U.S. Radium site remediation process is the debate it sparked about the disposal of radiologically contaminated material. In the early 1980's several homeowners were chosen to participate in a pilot study to excavate and remove contaminated soil.[262] However, the pilot project quickly went sideways when the state of New Jersey failed to

[259] Essex County property records, Essex County, New Jersey.
[260] United States Environmental Protection Agency, "Montclair/West Orange Radium Start One Administrative Record File Index of Documents," accessed February 2020. https://semspub.epa.gov/work/02/115239.pdf
[261] Note that installing lead sheeting is not without its own risks to human health, as lead is also a toxic material.
[262] United States Environmental Protection Agency, "Montclair/West Orange Radium Start One Administrative Record File Index of Documents," accessed February 2020. https://semspub.epa.gov/work/02/115239.pdf.

find an adequate disposal site for the yards of soil being removed each day. For months, residents watched as round metal 55-gallon hazardous waste drums piled up on their neighbors' front lawns. The homeowners of affected properties themselves had been evacuated while work was taking place.[263] They ended up being stuck in limbo, living in rented units, as their homes became ground zero for an increasing pile of low-level nuclear waste.[264] Over 5,000 drums were stacked in the front yards of four homes, and another 10,000 were temporarily stored at an industrial site in Kearney.[265] The contamination was invisible no more.

For two years, the barrels sat covered in blue tarps in the suburban neighborhood.[266] Attempts to temporarily move the waste to an armory in West Orange, a gravel pit in Vernon Township, and a wildlife refuge in Jackson Township were all unsuccessful.[267] Relocation plans were blocked by vehement protests and legal action on the part of the receiving municipalities. After several lawsuits, significant media attention, enduring NIMBYism, and a scramble by New Jersey authorities to come up with creative ways of disposing of the soil, it eventually found a permanent home. In 1987 some of the contaminated material was shipped to the former Manhattan Project site at Oak Ridge, Tennessee.[268] Other barrels of waste were shipped to Clive, Utah, a for-profit nuclear waste dump located in the middle of the Utah desert.[269] Area residents gathered to cheer as the barrels were loaded onto a truck for transport.

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[263] US EPA, "Montclair/West Orange Radium Administrative Record File Index of Documents."
[264] US EPA, "Montclair/West Orange Radium Administrative Record File Index of Documents."
[265] Narvaez, Alfonso A, "Jersey Starts Removing its Radium-Tainted Soil," The New York Times, July 30, 1987.
[266] Narvaez, "Jersey Starts Removing its Radium-Tainted Soil."
[267] Narvaez, "Jersey Starts Removing its Radium-Tainted Soil."
[268] Narvaez, "Jersey Starts Removing its Radium-Tainted Soil."
[269] The facility at Clive is owned by EnergySolutions, and they have received waste products from many of the sites discussed in this thesis. Debbie Galant, "Living with a Radium Nightmare," *The New York Times,* September 29, 1996, https://www.nytimes.com/1996/09/29/nyregion/living-with-a-radium-nightmare.html.

Figure 3.3: Barrels of radioactive soil sit underneath tarps in Montclair, New Jersey. Source: "Jersey Starts Removing its Radium-Tainted Soil," *The New York Times,* July 30, 1987.

Community Organizing

The local community played a large role in shaping the remediation and preservation outcomes in Orange. Originally, the EPA had planned to perform only a partial "cleanup of the site" at the end of the pilot project, using a combination of engineering and institutional controls (such as fencing) to permanently separate people from radium hotspots that were costly to remove. Houses would have been demolished and deed restrictions placed on the remaining land. However, local citizens did not want to see their neighborhoods razed, and were outraged at the plan. They fought back and formed the "Lorraine Street Committee for a Radium-Free Glen Ridge", members of which successfully lobbied members of Congress into setting up a meeting

between residents and the head of Superfund.[270] A full remediation with removal of all contaminated material was eventually approved.[271]

> "The other option was simply tear the houses down and put fences in the area and create 100 little radon parks... that would have been an outrage. That would have contaminated the entire community."
>
> -- Edward M. Callahan Jr., Mayor of Glen Ridge during the cleanup era, 1996. As quoted in Debbie Galant, "Living with a Radium Nightmare," *The New York Times*, September 29, 1996. https://www.nytimes.com/1996/09/29/nyregion/living-with-a-radium-nightmare.html.

As the mayor's remarks above illustrate, the decision to carry out a careful remediation in Glen Ridge was a political rather than practical one. The neighborhood was wealthy,[272] and its residents were well connected. This likely helped them avoid some of the more typical remediation tactics that have been employed by the EPA at Superfund sites in less privileged locales, such as the forced demolition of contaminated buildings. It is also interesting to note the relationship between visible and invisible contamination. In the mayor's remarks above, the entire community was already contaminated, but the possibility of visible destruction brought on by the proposed remediation was seen as a contamination in its own right. These views also factored into the way remediation was eventually carried out. A news article from 2009 notes that knocking down houses would have been cheaper in many cases, but mayors of the affected towns feared blight, so the EPA "got into the renovation business in a big way".[273]

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[270] Debbie Galant, "Living With a Radium Nightmare," *The New York Times*, September 29, 1996. https://www.nytimes.com/1996/09/29/nyregion/living-with-a-radium-nightmare.html.
[271] Galant, "Living With a Radium Nightmare."
[272] In 1999 the median income in Glen Ridge was $105,638, more than double the average median income for the county at the time. http://www.glenridgenj.org/pdfs/2003MasterPlan.pdf.
[273] Eliot Caroom, "EPA Wraps up Long Cleanup of U.S. Radium Pollution in Essex County," *The Star-Ledger*, May 4, 2009, https://www.nj.com/news/local/2009/05/epa_wraps_up_long_cleanup_of_u.html.

As the contaminated buildings were being remediated, a huge effort was generally made to preserve the buildings as they stood. (The exception to this is the U.S. Radium plant buildings, which were demolished.) Each homeowner worked with the building contractors to develop a plan to restore the property back to how it had stood before the contamination was discovered. This included the surrounding landscaping as well as the house itself. In at least one case "quite a rose garden" was documented, torn apart, and meticulously replaced.[274] Homeowners documented the current conditions of their properties with photos and videotapes, and contractors were expected to restore them perfectly once the work was completed.[275]

EPA documents[276] also reveal that investigators went to some effort to obtain the original plans for each building, with the intent to restore the property back to an "as-built" condition. Investigators noted the fact that many of the properties for which they had been able to obtain original construction drawings had been substantially altered over the years. Though this hunt for original plans seems to have been done for practical reasons, it raises interesting questions for the preservation of buildings impacted by radiological contamination. It also highlights some of the complications of remediating buildings in a way that ensures they are left standing.

Preservation Issues and Outcomes

Preservation and Restoration

The fact that contaminated houses were allowed to remain standing at all (despite the added expense compared to demolition) stands in stark contrast to how other buildings with similar contamination issues have been "remediated". The attempt by the EPA to restore houses

[274] Caroom, "EPA Wraps up Long Cleanup."
[275] Caroom, "EPA Wraps up Long Cleanup."
[276] United States Environmental Protection Agency, "Montclair/West Orange Radium Start One Administrative Record File Index of Documents," accessed February 2020. https://semspub.epa.gov/work/02/115239.pdf.

to "as built" and pre-construction conditions is also notable from a preservation perspective. It is generally understood that the way a building is drawn in construction documents is rarely exactly how the building turns out. Decisions are made during construction that can impact the final house. Therefore, restoring a building based solely on construction documents is, in some ways, restoring a version of the past that never existed. It also raises the issue of the building's period of significance. Even though residential properties don't seem to have been evaluated for historic significance, they could be considered historically significant as a record of the contamination that occurred (and, potentially, of the earlier history of the dial painting industry).

HABS/HAER Documentation

The U.S. Radium buildings located elsewhere in the neighborhood were heavily contaminated and scheduled for demolition in 1999 as part of the Superfund cleanup process.[277] However, the New Jersey SHPO also recognized the potential historic significance of the plant structures that remained standing. In 1997 a cultural resources investigation carried out by Grossman and Associates found that the former plant site was historically significant and eligible for listing on the National Register of Historic Places.[278] As part of Section 106 compliance and to help mitigate the effects of the demolition of the remaining plant buildings,[279] HAER documentation was completed two years later, in 1999.

[277] Information about the demolition of the U.S Radium buildings is lacking in the public record, and it is not clear from available information where the rubble from them eventually ended up. Materials from the associated nearby Superfund areas were sent to Oak Ridge, Tennessee, and Clive, Utah, so it is possible that the buildings themselves (or what remained of them) met a similar fate.

[278] "Historic American Engineering Record: US Radium Corporation," HAER No. NJ-121, http://lcweb2.loc.gov/master/pnp/habshaer/nj/nj1600/nj1643/data/nj1643data.pdf, 2.

[279] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Supefund's Record," *The Public Historian,* (Spring 2001), 23:2, 47-61.

This HAER documentation contains an extensive and well-researched history of the site, including detailed information about U.S. Radium's development as a company. Interestingly, the contamination itself had an impact on how thoroughly the building could be documented. The HAER report notes that:

> Due to human health concerns arising from elevated levels of radiological contamination within the buildings, USEPA determined that restricted access to the buildings' interior area was advisable and preferred. Therefore, only limited interior photographic documentation, in addition to exterior photographic documentation, was conducted to fulfill the New Jersey Historic Preservation Office's stipulation.[280]

In this way the HAER documentation itself serves as a record of the implications of radiological contamination. It also illustrates the limits of documentation as a way of preserving the history of radiologically contaminated buildings.

Figures 3.4 and 3.5: Images taken during the HAER documentation of the U.S. Radium Building in Orange, New Jersey. Source: "Historic American Engineering Record: US Radium Corporation Paint Application Building," HAER No. NJ-121-A.

[280] "Historic American Engineering Record: US Radium Corporation Paint Application Building," HAER No. NJ-121-A, https://cdn.loc.gov/master/pnp/habshaer/nj/nj1600/nj1644/data/nj1644data.pdf

The structures in New Jersey contaminated by U.S. Radium could potentially fall into multiple periods of significance and associations with historic events. However, during the remediation process only the buildings directly associated with the U.S. Radium Company during the time they occupied the site were considered historic. The HAER documentation set the remaining U.S. Radium buildings' period of significance from 1917-1926, the same timeframe that U.S. Radium occupied the site. If any of the contaminated buildings outside of the U.S. Radium site were evaluated for historic significance, there is no record of this in the publicly available documentation presented online, which is, admittedly, limited.[281]

However, there is no obvious reason to discount the possibility that the properties involved may have been considered historically significant, even under a standard preservation framework. According to Essex County property records, the majority of the contaminated houses in Montclair were constructed during one of two major phases of residential development of the area. The first occurred ca. 1928, shortly after the U.S. Radium plant shut down, as the area changed from a rural enclave to a suburban residential community. The second round of development occurred ca. 1957 and filled in remaining lots in the neighborhood. The houses are typical of popular styles during their respective eras, with vernacular Revival style houses appearing in the late 1920's and split-level and ranch style homes emerging in the mid-to-late 1950's. The Revival style houses showcase an eclectic mix of Tudor Revival and Colonial Revival style architecture, with off-center, cross-gabled entrance ways that are so asymmetrical as to be unsettling to observe. Some of the houses in the neighborhood have undergone substantial alterations, such as the installation of vinyl siding or the addition of a third story.

[281] A complete set of project records have been archived in New Jersey, but these could not be accessed by the author due to travel restrictions imposed in response to the COVID-19 pandemic.

However, many remain remarkably intact, particularly given the circumstances of their construction and subsequent remediation.

Figure 3.6: Houses along Nishuane Road in Orange, New Jersey. Source: Google Street View.

Visibility, Memory, and Memorialization

For two years, the debate over nuclear waste storage played out in a highly visible manner in Orange. One news article heralded the piles of radioactive waste drums stacked in suburban yards as "a bleak monument to the public mistrust of government".[282] However, they could just as easily be seen as a monument to the destructive legacy of nuclear production. The

[282] Eugene Carlson, "Suburban Radium Lode Gives New Jersey Disposal Headache," *The Wall Street Journal,* December 23, 1986.

barrels, which stood quite high, "nearly enveloping seven small houses",[283] made the problems of nuclear waste highly visible. They granted a temporary spatial presence to the history of contamination, and clearly showcased the impact that the remediation process itself had. Even though the houses were all eventually restored, the excavation of thousands of tons of soil was inherently disruptive. And such a remediation is, in many ways, a best-case scenario. Yet it seems as if once the remediation was completed the neighborhood did not retain any of the visible signs of what had happened. There are many potential reasons for this, not the least of which is a radioactive waste site's impact on property values. It is likely that residents do not want to advertise the fact that their homes once stood atop piles of radon-producing tailings. Local politics likely also played a role. Currently, individual properties impacted by the contamination are difficult to identify without deeper research. Based on Google street view images,[284] the houses that are identified in the EPA documents as having undergone extensive remediation work do not look any different from their neighbors. The average person would have no idea that anything unusual had happened in the neighborhood when walking through it today.

Today, the site where U.S. Radium operated for years looks like any other New Jersey neighborhood. The history of industry, contamination, and remediation is almost entirely invisible. Google maps does list the original site of U.S. Radium, which is somewhat unusual, though that still does not help locate the formerly contaminated residential areas. College Park, which is located atop the former plant site, does not have any sort of marker that might indicate what had happened there. The park itself is named in a rather generic fashion for the banners of various colleges that were to be installed around the park facility. According to a press release,

[283] Carlson, "Suburban Radium Lode."

[284] A field visit to determine the extent of visible history in the built environment was planned, but could not be completed due to travel restrictions imposed during the COVID-19 pandemic.

the purpose behind the banners is to "inspire children to treat higher education as an expectation rather than an option". It is unclear how the simple presence of collegiate logos in a recreational space is supposed to convey the message that higher education is an expectation rather than an option, especially in the absence of any related educational programming. However, the naming of the park certainly seems like a missed opportunity for the community to acknowledge its painful past, and to interpret the very important history that happened there. The name focuses on community need, yes, and it is possible that residents did not want a visible reminder of the history of U.S. Radium in their neighborhood despite the fact that the building once stood there. But ascribing a purpose to the park that is entirely unrelated to the history of the site seems rather disingenuous, and the history of the site seems to have been intentionally erased in this instance. To have a "blank" park with no purposeful subtext is one thing, but to have a park with an intentional subtext that is completely out of context is another.

It is also important to note that the Radium Girls were largely prevented from attending institutions of higher learning - one young woman named Katherine Schuab started a home study course at Columbia University (the only way women could "attend" Columbia at the time) only to experience a terrible remission of her illness.[285] She eventually died of radium poisoning a few years later. Part of the tragedy associated with the Radium Girls' premature deaths is the fact that they could not go on to do other things such as attend college or finish writing their autobiographies (though the portion of Katherine Scwab's book that she had managed to complete was eventually published). Therefore, the choice of college-related banners clearly presents a narrative that does not match the sites' history, and is, in some ways, antithetical to it.

[285] Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935*, (Chapel Hill: University of North Carolina Press, 1997), 212.

With College Park's established operating narrative working against the possibility of official recognition, both histories - of U.S. Radium and the Radium Girls, and of the impact of radiological contamination on nearby communities - are presently invisible. However, that does not mean that some form of historical interpretation could not take place there in the future. The fact that the formerly contaminated built environment largely remains standing opens up opportunities for interpreting the history of U.S. Radium and broader issues of nuclear contamination. The history may not be obvious, but elements of the built environment associated with it remain. In fact, this history has been afforded a remaining presence in the above-ground built environment that is rarely seen in cases of low-level nuclear contamination. This outcome would be desired by many communities dealing with the same issues, and the residents of Orange, New Jersey should be proud that their community has been successfully remediated without the destruction that has occurred elsewhere. Even if the original history of U.S. Radium is not interpreted, the history of contamination and remediation could be presented as a success story and interpreted in a place-based manner. After all, an entire neighborhood that faced the incredible impacts of widespread nuclear contamination remains standing today.

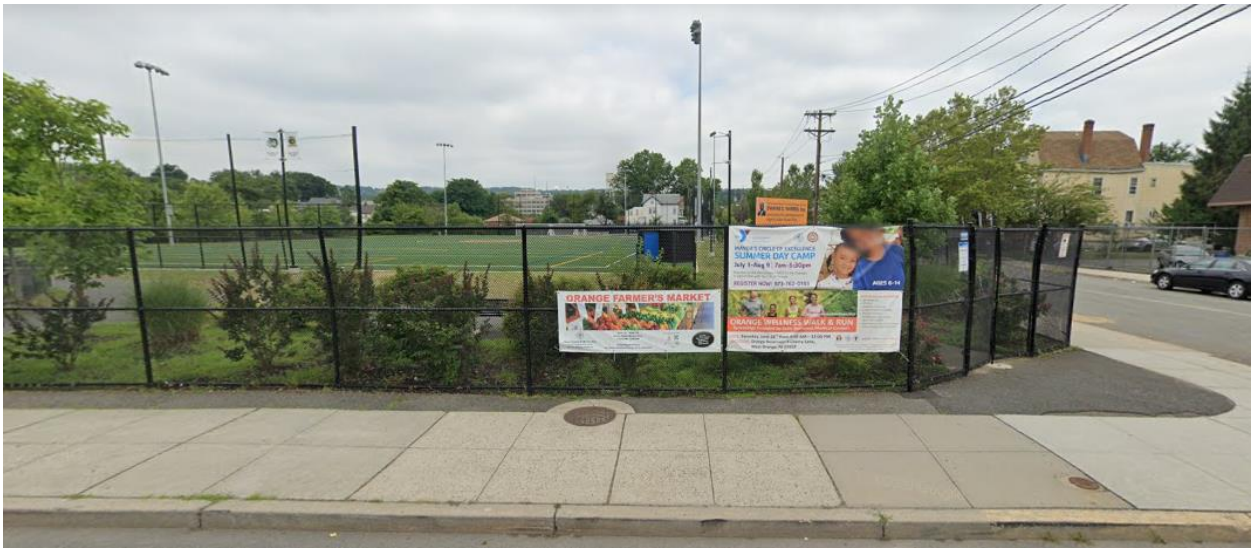

Figure 3.7: College Park. Source: Google Street View.

Chapter 3: Ottawa, Illinois Radium

Overview

This chapter will discuss the history of the radium dial painting industry in Ottawa, how remediation was carried out, preservation issues, and current site conditions. The history of the radium industry in Ottawa, Illinois, the third case study in this thesis, closely follows that of Orange, New Jersey. Both towns had radium watch dial painting plants, and both are associated with the Radium Girls. The Radium Dial Company operated in a former high school building from 1920-1932, when it "went out of business". However, in a thinly-veiled act of subterfuge, the owners of Radium Dial subsequently opened Luminous Processes, Inc. in the same year, which operated in a different building from 1932-1978. Together the companies were responsible for extensive radium contamination in the Ottawa area. Unlike U.S. Radium, the Ottawa plants were equipped only to paint the dials, not to process carnotite ore. However the buildings themselves were extensively contaminated with radium. In this chapter particular attention will be paid to the Radium Dial Memorial, which is one of the few interpretive interventions found in the case study sites.

Figure 4.1: The Luminous Processes Building, Ottawa, IL., ca. 1930's. Source: Ottawa Historical and Scouting Heritage Museum.

History

The Radium Dial Company was founded in 1917 as a subsidiary of Standard Chemical Company (the same Standard Chemical Company run by Joseph Flannery, and that founded Uravan, Colorado). According to the Environmental Protection Agency the dial painting studio in Ottawa opened in 1920, though other sources put the date in the late 1910's,[286] 1918,[287] 1922,[288] or 1923.[289]

Housed in an old former high school, Radium Dial operated for twelve years before reincorporating as Luminous Processes, Inc. in a new structure in downtown Ottawa. The new building was located just five blocks from the original Radium Dial site, and while the companies were different on paper, the work remained almost entirely the same. The building held rows of desks where the Radium Girls toiled, dipping brushes to radium paint, and then to their mouths. Notably, it is very likely that Uravan, Colorado, was the point of origin of the radium used in the paint until at least 1922, when Belgian ore supplanted domestic ore in the radium marketplace.[290] Though the New Jersey Radium Girls made headlines with their stories,

[286] U.S. Department of Health and Human Services, "Public Health Assessment for Ottawa Radiation Areas, Ottawa, IL," July 25, 2006, https://www.atsdr.cdc.gov/hac/pha/ottawaradiationareas/ottawaradiationareaspha072506.pdf.
[287] Plaque at Radium Girls Memorial, Ottawa, IL
[288] Robert F. Robinson, *Mining and Selling Uranium,* (Bloomington: Springer, 2015), https://link.springer.com/content/pdf/10.1007%2F978-3-319-11830-7.pdf, 155
[289] Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935*, (Chapel Hill: University of North Carolina Press, 1997), 99.
[290] "Radium $70,000 a Gram: $50,000 Drop Is Due to Belgian Congo Find of Rich Ore," The New York Times, November 29, 1922.

news of the dangers of radium paint took longer to reach Ottawa, IL.[291] The tragedy there was just a few years behind.[292]

By the 1980's the story of the Radium Girls was well-known in Ottawa. The company had an extremely visible presence in the area for decades, and by the 1930s Ottawa had gained a nation-wide reputation as "Death City".[293] At least 40 local Radium Girls died horrifying deaths, their stories becoming part of family histories, and engrained in the town's collective memory.[294] However, despite this, the radiological contamination in the surrounding communities was not discovered until 1982.[295] By happenstance a local resident named Ken Ricci bought a geiger counter at a garage sale, and in experimenting with his new gadget he discovered several hotspots of radiation throughout the town.[296] In an illustration of how quick communities can be to ignore and forget, at that point the Luminous Processes plant had only been closed for four years. Yet the town officials remained ignorant about where the radioactive waste was buried, and they refused to acknowledge that the boarded-up plant building could be at all dangerous.

Ricci's discovery spurred official action, and sixteen separate areas of contamination were eventually catalogued by the EPA. The Ottawa Radiation Areas site was listed on the

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[291] In part because of company efforts to suppress the information.

[292] For a full history of the radium girls in Ottawa, see Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935* (Chapel Hill: University of North Carolina Press, 1997) and Kate Moore, *The Radium Girls: The Dark Story of America's Shining Women* (Napervill: Sourcebooks, Inc., 2017).

[293] Micheal Wilmington, "Movie Review: 'Radium City' Paints Incredible Horror Story of the Atomic Age," *Los Angeles Times*, January 9, 1988, https://www.latimes.com/archives/la-xpm-1988-01-09-ca-8748-story.html.

[294] Casey Buckro, "Radium Poison a Nightmare for Small Illinois Town," *Chicago Tribune*, September 21, 1980.

[295] Mary Hansen, "Illinois Issues: The Radium Girls - Cleaning Up Contamination," *Illinois Public Media*, February 6, 2018, https://will.illinois.edu/news/story/illinois-issues-the-radium-girls-cleaning-up-contamination.

[296] Hansen, "The Radium Girls - Cleaning Up Contamination."

National Priorities List in 1991.[297] The Ottawa Radiation Areas site includes contamination from both The Radium Dial Company and the company's successor at Luminous Processes.

The Radium Dial Company building itself came back to haunt the local community. The former high school building that had housed Radium Dial was demolished in 1968, and the building material was spread as fill in the surrounding areas as well as placed in the local landfill.[298] Contamination in Ottawa was found in highly concentrated patches in residential and commercial neighborhoods. This is due, at least in part, to the origin of the radioactive material. Ottawa dealt only with purified radium, and did not produce the piles of ore tailings that were found in other locales.

Remediation

As part of the remediation process, the Illinois Department of Nuclear Safety removed contaminated soils near homes starting in 1986.[299] They also purchased one home outright (it is not clear from the available literature what happened to it - presumably it was demolished). Radon reduction systems were installed in the basements of two homes and a business in 1988.[300] In 1990 another house was moved offsite, to a parcel of uncontaminated land that the homeowner had purchased.[301] Unfortunately very few details about the house moving process exist in the available literature, as this seems to be a very rare outcome in dealing with radioactive waste contamination, and one worthy of further investigation. In 1994 other areas with contaminated soil were excavated, and were shipped to a low level waste disposal site in

[297] United States Environmental Protection Agency, "Ottawa Radiation Areas Ottawa, IL Cleanup Activities," accessed February 2020, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0500634#bkground.
[298] US EPA "Ottawa Radiation Areas Cleanup Activities."
[299] US EPA "Ottawa Radiation Areas Cleanup Activities."
[300] US EPA "Ottawa Radiation Areas Cleanup Activities."
[301] US EPA "Ottawa Radiation Areas Cleanup Activities."

Utah (this is very likely Clive, Utah, which receives materials from many of the case sites discussed in this thesis).[302] All in all, about 32,000 cubic yards of contaminated soils were removed during the early phases of remediation.[303]

The Illinois Department of Nuclear Safety also tackled the Luminous Processes Inc. building, which was still standing at the time. The building was demolished in 1985-1986, and the remnants of it were shipped to Hanford, Washington for burial.[304] It is not clear if any steps were taken to document the Luminous Processes building before it was demolished. The demolition of Luminous Processes pre-dated the site's Superfund designation, so it is possible that the project did not use any federal funds, thereby avoiding Section 106 compliance requirements. Aside from preservation issues, the demolition seems to have been botched in other ways. At a town meeting to discuss how to best deconstruct the building, the mayor downplayed the issue of radiological contamination and threatened to have anyone who asked a "rude question" escorted out by the police.[305] Town officials also hosed down the factory site, thereby contaminating the local groundwater.[306] (EPA documents note the extensive groundwater contamination but do not discuss its origins.)

Most of the homes impacted by the contamination were treated somewhat more carefully. Based on the available documentation, at least five homes built near or on top of contaminated soil were remediated in 1997.[307] There are likely others with different dates that are not specifically mentioned in the publicly available online EPA reports, which are limited at the time

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[302] US EPA "Ottawa Radiation Areas Cleanup Activities."
[303] US EPA "Ottawa Radiation Areas Cleanup Activities."
[304] US EPA Document, accessed February 2020, https://semspub.epa.gov/work/05/920013.pdf.
[305] Janet Maslin, "Film Festival; A View of the Radium Dial Horror," *The New York Times*, September 26, 1987, https://www.nytimes.com/1987/09/26/movies/film-festival-a-view-of-the-radium-dial-horror.html.
[306] Maslin, "A View of the Radium Dial Horror."
[307] OHM Corp, "Reports for the Removal of Radium Contaminated Soils," 1996-97, accessed February 2020, https://semspub.epa.gov/work/05/946957.pdf.

of this writing.[308] It is unclear if any of the five houses had installed radon treatment systems prior to the removal of contaminated soil, however it is likely that levels high enough to justify soil removal would have been remedied through an indoor air approach in the interim for health and safety reasons. In instances where contaminated soil occurred underneath a house, a team of workers was sent into the crawlspace with hand shovels.[309] Exterior contamination was removed with backhoes. Remediated areas were "restored" with compacted dirt. Previously paved areas were re-paved, and gravel driveways were replaced. The fate of planted landscaping is not mentioned in the available reports, though in at least one instance a garden plot was restored.[310] The buildings themselves were largely untouched during cleanup, except for the two instances mentioned above where buildings were purchased and moved. It is not known if this difference in cleanup method was due to the levels of contamination found at each property, or based on other factors.

Community Organizing

Community activism also played a role during the cleanup of Ottawa. The "Residents Against a Polluted Environment" group was originally formed to fight a proposed hazardous waste landfill in Ottawa.[311] However, Ken Ricci was a member, and after he picked up several radioactive hotspots in town with his garage sale Geiger counter the group's focus changed. In the early 1980's they petitioned the mayor for a fence to be placed around the Luminous Processes building, which was still standing at the time. However, the mayor's response was that

[308] Due to the COVID-19 pandemic, it was not possible to obtain more accurate records.
[309] OHM Corp, "Reports for the Removal of Radium Contaminated Soils."
[310] OHM Corp, "Reports for the Removal of Radium Contaminated Soils."
[311] Hansen, "The Radium Girls - Cleaning Up Contamination."

the group would "ruin the city's reputation" if they kept talking about radiation.[312] Eventually, several factors helped force the town to take the contamination seriously. The state representative for the area, Peg Breslin, got involved in the battle and pushed for state funding to demolish the Luminous Processes building.[313] A documentary called "Radium City" was also produced, which told the story of the radium girls and the contamination left behind by the company's tenure.[314] A year later a helicopter-based radiological survey of the area was finally completed.[315] It is not clear what influence the group may have had on remediation decisions made after the site became a Superfund site, but it is likely that their efforts helped jumpstart the overall process.

Preservation Issues and Outcomes

Visibility, Memory, and Memorialization

Given the limited information available, it is difficult to determine the current status of many of the residential buildings impacted by radiological contamination in Ottawa. The few contaminated houses that have published addresses[316] are all located in an area without existing Google Street View footage. However, no evidence of the remediation process remains visible from satellite footage. The houses, yards, and landscaping are all completely indistinguishable from their neighbors when viewed from above.

The two buildings where Radium Dial Co. and Luminous Processes operated have been demolished, and only the Luminous Processes site is marked. Furthermore, quite a bit of confusion exists in the available literature as to where the earlier Radium Dial Co. was located,

[312] Hansen, "The Radium Girls - Cleaning Up Contamination."
[313] Hansen, "The Radium Girls - Cleaning Up Contamination."
[314] Hansen, "The Radium Girls - Cleaning Up Contamination."
[315] Hansen, "The Radium Girls - Cleaning Up Contamination."
[316] The addresses are 1618 Poplar Street, 1620 Poplar Street, 927 Deleon Street, 1623 Mulberry Street, and 1625 Mulberry Street.

suggesting that the building's history has not been well documented.[317] However, a fire insurance map[318] from 1913 shows the Township High School at the southeast corner of Columbus and Washington Streets in downtown Ottawa, confirming that this site is where Radium Dial Co. once stood. Based on Google Street View images, this site is now a vacant parking lot. According to the EPA, the site of Luminous Processes, Inc. (the later version of the company) was at the northwest corner of Jefferson and Clinton Streets in downtown Ottawa. Notably, these two sites are located just five blocks apart.[319] This site is also used as a parking lot, but it is also the site of the recently installed Radium Girls Memorial.

The town of Ottawa clearly represents the history of the radium girls with the Radium Dial Memorial, which is one of the few memorials to radium contamination-related history in the country. The Radium Dial Memorial is located at the corner of Clinton Street and Jefferson Street in Ottawa, Illinois, at the corner of the former site of Luminous Processes, Inc.[320] In 2006 an eight grade student in a local school named Madeline Piller was amazed to learn about the history of her hometown, and surprised that others did not seem to know about it.[321] She wrote her local representatives to urge them to erect a radium girl memorial.[322] Madeline Piller's father was a sculptor, and he was eventually awarded a commission to produce a memorial by the town.[323] The city was responsible for designing "the plaques and or signage needed to provide visitors with a real understanding of the Radium Girls story and make their visit as meaningful as

[317] U.S. Department of HHS, "Public Health Assessment for Ottawa Radiation Areas, Ottawa, IL."
[318] Sanborn Map Co., Insurance Maps of Ottawa, Illinois, September 1913.
[319] US EPA Document, Accessed February 2020, https://semspub.epa.gov/work/05/920013.pdf.
[320] The plaque of the statue itself mentions this fact, however it is not clear on the official Ottawa visitor's association webpage.
[321] Roadside America, "Statue of the Radium Girl," accessed February 2020, https://www.roadsideamerica.com/story/32596.
[322] Roadside America, "Statue of the Radium Girl."
[323] It's unclear how much William Piller's status as a sculptor shaped the campaign to erect a statue.

possible."[324] In a letter supporting the memorial, the mayor of Ottawa acknowledge the importance of the history of the radium girls, stating

> The tragic and courageous story of the radium girls is an important part of the history of the City of Ottawa which deserves to be recognized and remembered by the citizens of Ottawa. It is also a story which needs to be shared with those who visit Ottawa.[325]

The bronze statue was unveiled in 2011. It sits within a small paved plaza, and depicts a radium girl holding a wilted tulip. An informational plaque is located nearby, and a small water fountain runs behind the statue.

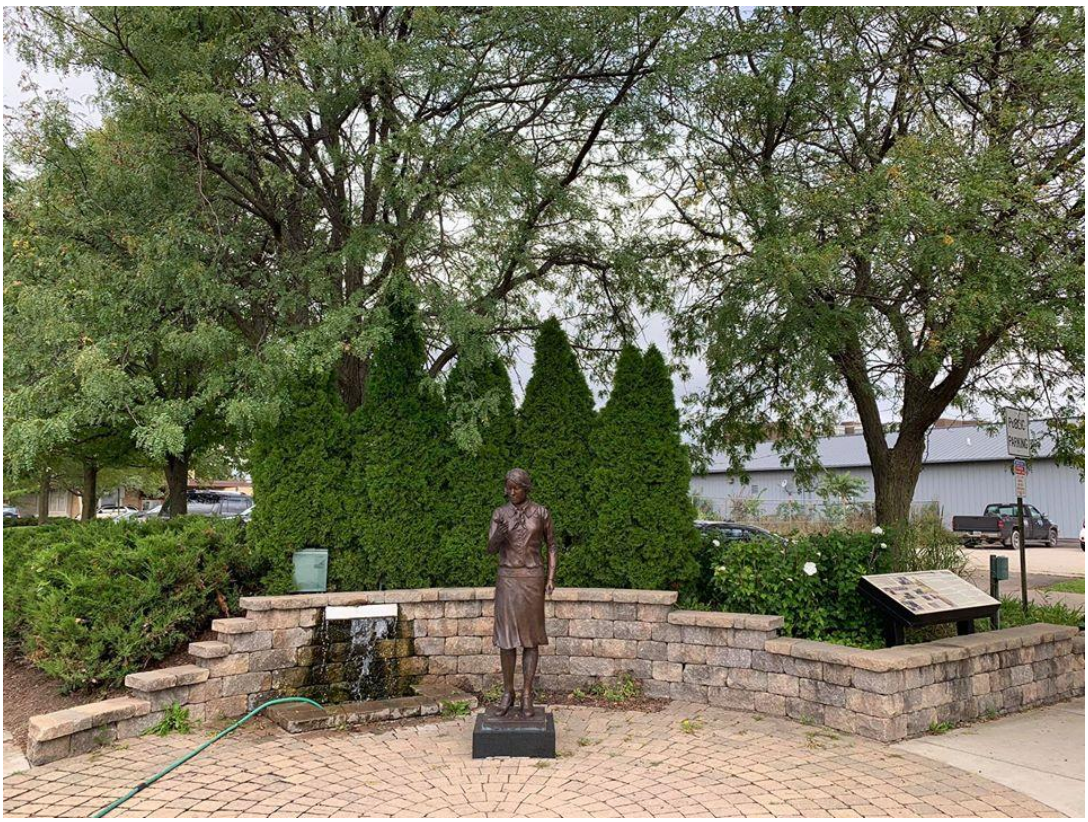

Figure 4.2: The Radium Girls Memorial at the former site of Luminous Processes, Inc.
Source: Caitlin Lane, Radium Girls Memorial Facebook Page, October 7th, 2019.

[324] Letter from Robert E. Eschbach to Madeline Piller, July 30, 2010, accessed May 2020, http://www.williampiller.com/radiumgirlsmonument.html.
[325] Letter from Robert E. Eschbach to Madeline Piller, July 30, 2010.

The Radium Girls Memorial is an extremely important development in the history of remediating radiologically contaminated sites. It does what the citizens of Uravan hoped for and what is so absent at College Park in New Jersey: mark the place where this important history happened. The statue has an accompanying plaque, which lays out the history of the site, the radium girls, and the contaminated buildings. Though it does not geographically locate the rest of the contaminated areas, it does mention that they exist. This is a major first step in acknowledging that the history of the radium girls did not end with the closure of the plant, and that in fact the site that the statue sits on is only one of many important places that should be remembered. The Superfund cleanup process is also summarized. Importantly, the plaque also mentions where the contaminated material went - to Hanford, WA, in the case of the remains of the Luminous Processes, Inc. building. This situates the history of radium in the town within the larger landscape of nuclear waste disposal.

Figure 4.3: The informational plaque at the Radium Girls Memorial in Ottawa, IL. Source: Caitlin Lane, Radium Girls Memorial Facebook Page, October 7th, 2019.

The Radium Girls Memorial has its own Facebook page, and from the postings there it is clear that the site is important to many people. This may be driven, at least in part, by broader public interest generated by the recent publications of books and feature films on the radium girls.[326] However, photos show the statue dressed in a variety of hand-knit scarves and hats, and even holding a bouquet of fresh flowers. This illustrates that people are, in fact, visiting the site, and engaging with the history that happened there. A Facebook page is not an accurate measure of the statue's visitorship by any means, but it does show that at the very least the statue is not entirely neglected. People in the community are interacting with the space. The last line on the plaque reads "Their stories are not lost and will not be forgotten". The statue, it seems, is at least currently helping to ensure that this is the case.

Figure 4.4: A woman poses while tying a scarf on the Radium Girl Memorial. Source: Caitlin Lane, Radium Girls Memorial Facebook Page, October 7th, 2019.

[326] Such as the recently released "Radium Girls" movie (https://www.nj.com/entertainment/2020/02/njs-radium-girls-made-history-by-seeking-justice-now-their-story-is-headed-to-theaters.html) and the book by Kate Moore, *The Radium Girls: The Dark Story of America's Shining Women* (Naperville: Sourcebooks, 2017).

Chapter 5: Findings and Recommendations

The three case studies explored in this thesis illustrate different preservation outcomes, though several themes begin to emerge. Both interpretive and remedial efforts at these sites have run a gamut between complete demolition and careful preservation. In Uravan, Colorado, the entire city was eventually destroyed, despite community members' best efforts. In Orange, New Jersey, most buildings were saved and meticulously restored, but the site where the radium plant once stood is now a park that completely ignores its historical origins. In Ottawa, IL some buildings were demolished, but a memorial was installed to ensure that the history would not be forgotten. Based on these findings it is possible to propose recommendations for the future that may allow preservationists to more effectively engage with the remediation of radiologically contaminated historic sites.

Community Involvement as a Powerful Tool

All three case studies discussed in this thesis showcase the important role that community activism can play in the environmental remediation process. While this leadership did not always lead to the desired preservation outcomes, it often served to highlight many of the issues surrounding preservation and inherent conflicts within the EPA process. It is also clear that many of these historic landscapes are valued by people. From the radium girl statue being fitted with hand-knit woolen scarves in Ottawa, to the years of advocacy work to save the last two buildings in Uravan, local community members have shown again and again that they care about these

places. Furthermore, preservation losses incurred during the remediation can serve as a rallying point for future interpretive work. This was seen at Uravan in particular, where members of the Rimrocker Historical Society fought valiantly for the preservation of the town's last two buildings, winning a preservation award in the process. Though the buildings were eventually demolished, the group continues to fight for a museum or other commemorative intervention at the site.

In Orange, New Jersey, community organizing was successful in ensuring that contaminated homes would not be demolished. Members of the Lorraine Street Committee for a Radium-Free Glen Ridge were able to meet with the head of the EPA and argue for a different approach. Their efforts, combined with local politician's fears that a standard remediation approach might produce blight, led to the preservation of dozens of contaminated homes that might otherwise have been bulldozed. Residents also used tools often used by preservationists, such as documentation, to ensure that their buildings were restored to prior conditions after the remediation process was complete. This is one of the most successful examples of community members fighting for a more preservation-oriented remediation outcome, though historic interpretation remains lacking.

A group of concerned citizens in Ottawa, IL uncovered radioactive material hiding in plain sight throughout the town and pushed for it to be remediated. It took many years, but most of the areas of contamination have now been "cleaned up" and the toxic material moved elsewhere. In 2006, a young student named Madeline Piller virtually single-handedly began the process of calling for a radium girls memorial at the site of the former plant. Her efforts galvanized the community, and a statue was installed in 2011 with money raised from a variety of community organizations.

The case studies presented in this thesis highlight the fact that community involvement can play a crucial role throughout the remediation, preservation, and interpretation processes. However, community organizing is still highly intertwined with issues of race, class, and power. The residents of Orange, New Jersey were able to develop crucial political connections to push for a full remediation that were likely based in part on the town's reputation as a wealthy suburb. The ability to effectively fight for the preservation of contaminated buildings at an increased financial cost can be limited by a variety of socioeconomic factors, and community organizing may be more or less effective in certain instances. The EPA process is supposed to give everyone an equal voice, and Superfund cleanup projects should be completed with equal regard for residents' wishes, health, and well-being, but this is not always the case.

Differences Across Communities

One of the most important findings of this thesis is that there is no "one-size-fits-all" approach when it comes to integrating preservation within the environmental remediation process at places with radiological contamination. This is despite a vast network of Federal government regulations that should, in theory, work to ensure that contamination from uranium mine tailings, for example, is dealt with in an equal manner across locations.[327] However, as illustrated in the three case studies, places with very similar types of contamination have been remediated with strikingly different approaches that have led to vastly different preservation outcomes. As discussed above, in Orange, New Jersey, contaminated material was carefully excavated from affected residential properties, and every aspect of the home's structure and landscape was meticulously restored. However, in other instances such as Uravan, Colorado, the

[327] See UMTRA, the Uranium Mill Tailings Remediation Action, as well as Superfund/CERCLA, etc.

entire city, including entire blocks of houses, was demolished and buried. Information on how residential properties in Ottawa, Illinois were treated is lacking, but at least one house was purchased by the EPA and presumably destroyed, and another was moved off site. Others were allowed to remain standing, and show no evidence of the contamination that occurred.

Other relevant cases that were outside the scope of this thesis also illustrate how the Orange, New Jersey site contrasts with remediation approaches in other areas. The Navajo Nation has widespread contamination from uranium mill tailings that is somewhat similar[328] to the contamination found from U.S Radium in Orange, New Jersey. In this case the EPA has implemented a "Contaminated Structures Program" through Superfund.[329] The program requires that residents allow their home to be completely "removed" (demolished) if the building is contaminated.[330] The land around the home is also completely torn up, re-graded, and left as a bare plot of desert.[331] A new home or trailer is often installed in its place,[332] but that outcome is very different from the carefully replanted rose gardens and restored basements of New Jersey. (And even then it is only the lucky few that have had their homes treated at all - many more residents have waited years for anything to be done.)[333]

The differences across locations highlight the need for environmental justice to be better acknowledged and dealt with throughout the environmental remediation process. There is a clear inequity in how the preservation of radiologically contaminated historic structures has been

[328] Tailings were used more frequently as a concrete aggregate in the Navajo Nation, which could increase the complexity of the remediation process, but the basic problem is the same.
[329] United States Environmental Protection Agency, "Navajo Nation: Cleaning Up Abandoned Uranium Mines: Addressing Uranium Contaminated Structures," accessed March 2020, https://www.epa.gov/navajo-nation-uranium-cleanup/addressing-uranium-contaminated-structures.
[330] US EPA, "Navajo Nation: Cleaning Up Abandoned Uranium Mines."
[331] US EPA, "Navajo Nation: Cleaning Up Abandoned Uranium Mines."
[332] US EPA, "Navajo Nation: Cleaning Up Abandoned Uranium Mines."
[333] US EPA, "Navajo Nation: Cleaning Up Abandoned Uranium Mines."

carried out in the past. Certain communities are being afforded the power of having their meaningful historic properties be left standing, while others are facing certain demolition. It is no accident that historic buildings in the wealthy, white suburb of Orange, New Jersey have fared differently than those in other places, and this is something that preservationists need to have an active role in remedying in the future.

Section 106: Uses and Shortcomings

Section 106 of the National Historic Preservation Act of 1966 is meant to ensure that projects that use federal funds do not inadvertently cause a negative impact to historic resources without prior consultation with appropriate agencies (such as the State Historic Preservation Office). Because Superfund projects use federal resources by design, Section 106 will apply in most situations where severe radiological contamination has an impact on the built environment. It was difficult to find much information on the specifics of how Section 106 compliance was met in all of the cases discussed in this thesis. However, as discussed in the study by Fredrik Quivek[334] and highlighted in the case of Uravan, Colorado, the EPA has quite frequently failed to comply with Section 106 requirements when carrying out Superfund remediation projects.

The case of Uravan, Colorado illustrates what happens when remediation projects fail to comply with Section 106. In this instance those in charge of the remediation process did not realize that they needed to comply with Section 106, and they failed to consult with the Colorado SHPO. Even after the SHPO was brought on board, communication breakdowns were abundant, and historic buildings were demolished without the SHPO's knowledge. The Uravan Post Office

[334] Fredric L. Quivik, "Integrating the Preservation of Cultural Resources with Remediation of Hazardous Materials: An Assessment of Supefund's Record," *The Public Historian,* (Spring 2001), 23:2, 48.

was supposed to be preserved in accordance with SHPO's recommendations, but it was demolished before the SHPO could document it or otherwise intervene ahead of the scheduled demolition.

To improve the chances of Section 106 having a meaningful impact on the remediation process, those undertaking a remediation process should be encouraged to follow Section 106 compliance as much as possible according to federal and state guidelines. It is the responsibility of the federal agency completing the project to inform the SHPO of any project that might impact a historic property, but history shows that this is not always followed. Preservation professionals at State Historic Preservation Offices should be aware of environmental remediation projects happening in their state. They should contact the EPA to ensure that Section 106 is being followed if Superfund projects are being scheduled or undertaken without their knowledge.

However, even in cases where Section 106 compliance was followed and the EPA has a good working relationship with the SHPO, the end result may still be a project where important history is completely absent from the built environment, as happened in In Orange, New Jersey. HAER documentation was carried out on the historic U.S. Radium building as part of Section 106 review, but that did not have much of an impact on the final outcome.

Limitations of Documentation

Documentation can be a useful tool for preservationists, and it is often used to preserve a record of a building prior to demolition. In many cases documentation is much easier to carry out than a full remediation process that removes harmful building materials while leaving the structure intact and standing. However, documenting buildings with radiological contamination

is not always a simple task. In some cases the level of radiation inside the building can be so high as to pose an imminent risk to human health, which limits the ability of workers to document certain areas. This can be seen in the case of the U.S. Radium site in Orange, New Jersey. HAER documentation was carried out as part of the remediation process, but only a few areas of the interior could be photographed due to the high levels of radioactivity. As a result, the most contaminated (and, potentially, most important) sections of the building were left out. This has the unintended consequence of erasing the most contaminated parts of the building from the historical record, which therefore lessens the utility of a HAER style documentation in conveying an accurate record of the building's history and use in perpetuity. However, this documentation process itself does serve as a record of the building's contamination and risk, as long as such information is clearly communicated in the record. This is not the same as having a complete photographic record of the building, certainly, but it does at least serve as a reminder of the dangers inherent in these contaminated structures.

HABS/HAER style documentation is one standard in the field, though other more technologically advanced forms of documentation have emerged in recent years. None of the case studies presented in this thesis were recent enough to have benefitted from the emergence of documentation tools such as photogrammetry or laser scanning. It is possible that specialized equipment with radiation shields could be used to document contaminated sites in the future. However, these techniques require the assistance of experts, and the cost may be too high for this technology to be viable at the "average" radiologically contaminated site. However, radiation could still hinder documentation efforts, and dealing with the risk to equipment would likely significantly increase the cost. Overall, documentation is not necessarily a simple solution to the problem of how to preserve the memory of historic buildings when they may be too

contaminated to leave standing. It can serve an important role, but it is not a full substitute for place-based interpretation, or for finding a way of retaining the original historic built fabric.

Preservation Does Not Equal Interpretation

While preservation of as much of the historic built fabric as possible is an important goal during a remediation project, it is important to note that saving historic buildings from demolition or documenting them beforehand does not necessarily mean that the history that remains will be interpreted or acknowledged. Notably, the place with the most remaining built fabric, that underwent the most fine-toothed remediation, has the *least* amount of historic interpretation of the three sites. In Orange, New Jersey, the EPA had a good working relationship with the SHPO, and Section 106 was carefully followed. The U.S. Radium building was documented extensively as part of Section 106. Even though the building was highly contaminated and needed to be demolished for practical safety reasons, an extremely thorough HAER report lays out the building's history in impressive detail. Local community groups were also successful in fighting for all of the contaminated houses in the neighborhood to be preserved, despite the fact that demolition would have been a cheaper option. Each home was documented, contaminated soil was removed, and the building and landscape were impeccably restored. In many ways this case study represents the best-case scenario for how preservation and remediation can be carried out concurrently. However, the history of U.S. Radium, and of the environmental contamination that followed, is completely missing from the landscape today. Therefore, it is not enough to just save these buildings as they stand. The history of contamination needs to be made visible and interpreted. This may be an uphill battle in some jurisdictions, where politicians and others may resist acknowledging a negative history, but it is a crucially important task.

Interpretation can also have positive effects, beyond those associated with telling these crucial stories. Historic nuclear sites, when well interpreted, can serve as community gathering places and draw tourists and outside visitors to the town. They can help those impacted by the trauma of contamination to heal, and can offer reassurance to residents of places with similar issues that remediation and recovery is, in fact, possible in the future. Using only existing and well-established tools it is possible to preserve these important histories and interpret them effectively on-site, and emerging technologies and techniques will likely only open up more options in the future.

Expanding Beyond the Focus on Primary History

Furthermore, the histories of these important places should be expanded. In the cases where the histories of these places have been interpreted or documented from a preservation perspective, the focus is generally on the primary history of the site - for example the history of uranium mining or radium processing. The history of discovering contamination and of the remediation processes themselves are rarely discussed. The same is largely true for books and other documents written about the case sites. In the New Jersey Radium case, a lengthy statement of significance was written for the original U.S. Radium building, but the nearby houses that were constructed shortly after were not evaluated for significance. In Ottawa, Illinois, the memorial erected to the radium girls focuses largely on the primary history of the Radium Dial Company, Luminous Processes, Inc, and the tragedy of the girls' premature deaths. In this case the Superfund process is briefly discussed, which is a good start, but it is not physically represented in the statue itself or in the larger built environment.

However, the story of industry that created environmental and human health impacts is just one aspect of the broader history. It is important to know that these industries existed, but to valorize these through the inclusion in texts and monuments leaves out the crucial history of what happened to the waste materials after the plants closed. The secondary impact of these industries can be seen as just as significant as the original impact. It's also important that the history of contamination is included in broader public memory, as these issues will almost certainly continue to happen in the future.

The case studies also show what happens when we forget, when these histories are not adequately remembered. In Orange, New Jersey, it took a helicopter radiation survey to uncover where waste was buried. The contamination went unnoticed for decades. In Ottawa, IL, it took a local man buying a Geiger counter at a garage sale before anything was done. The signs were there - the radium production building was still standing - but the town had chosen to forget. Expanding the historic narrative could be crucial in ensuring that knowledge about nuclear contamination is embedded in our broader collective memory, so that the fact that waste may be buried in our own backyards may be recognized in the future.

Additionally, there are many other ways of interpreting these histories that are outside of the mold of the classical memorial installation. Imagine, for example, if the town of Uravan could have been left intact, still standing, but uninhabited. A ghost town of the nuclear age. Uravan may not have been safe for long-term occupation, but short tours likely would not have posed any risk to participants, and this could open up an untold number of interpretive possibilities. In Orange, New Jersey, perhaps a single building could have been left in a contaminated state and turned into a museum, or left with "temporary" mitigation efforts in place. Being able to physically inhabit a space such as one of the suburban homes impacted by

radium contamination could be an extremely powerful way of communicating risk. When remediation is carried out different materials and/or designs could also be used to convey the history of what happened there. New concrete of a different color could replace that once made with contaminated tailings sand, and the ground could be marked where radioactive soil was hauled away. There could be great power in letting these buildings show their scars.

Intersections with Other Historic Sites

Another notable finding of this research is that contaminated materials are often moved from one historic site to another. There are a limited number of places in the United States that have been "sacrificed" to the point where they are so radioactive as to be officially designated as contaminated for perpetuity. As a result, existing historic sites have become layered with the remnants of the built environment from across the broader landscape of nuclear production. Materials from the three case studies discussed in this thesis have ended up in Hanford WA, the Nevada Test Range, Clive Utah and Oak Ridge TN, at a minimum.[335] One potential avenue for future research is the exploration of the broader landscapes of disposal sites. Tracking where historic material from each site eventually ends up could be especially important.

Unlike other forms of environmental contamination, radioactive materials cannot be destroyed or rendered harmless. They can only be moved and buried in another place. Because these wastes pose a virtually permanent risk to human health (and the health of every other organism that comes in contact with them), it is crucial that the histories of these materials are not forgotten once they are hauled away. Therefore, histories of these places should include a

[335] The for-profit nuclear waste dump at Clive, Utah is an especially interesting example because it is one of the few places where low-level radiologically contaminated building material is disposed of that does not have its own history separate from that of disposal. It also holds material from most, if not all, of the sites discussed in this thesis.

running list that encompasses the life cycle of these radioactive materials, for each aspect of that life cycle has the potential to be historically significant. This may include the history of where the material originated (where it was mined and processed), how it was used (in industrial or other applications), where it ended up after that point (disposal around the plant site), and where it was eventually disposed of (its final resting places after the remediation had occurred). Together, these histories form a complex and layered landscape that tells the story of our country's nuclear era.

Preservationists Can Save More Than We Think

The positive side of the above findings is that it's possible to save more than we think. Though there is a tension between environmental remediation and preservation, it is not just the potential for negative health effects that is driving the decision-making process in many cases. The case studies examined in this thesis show that the tension between remediation and preservation is not intractable. The risk from contamination should always be considered, but it appears that the demolition of radiologically contaminated historic structures is by and large a bureaucratic, legal, and social issue, *not* a strictly technical one.

In Uravan, Colorado, two historic buildings were successfully remediated, deemed fit for human occupation, and restored. However, bureaucratic concerns over liability led to them being demolished by fire at the last minute. In this instance preservation's tools for preventing demolition did not work effectively - even a 20-year covenant required to be written into the land deed did not stop the demolition. However, this case does highlight the fact that there is often room, even in a case where an entire town is so contaminated as to warrant demolition, for the preservation of significant structures to occur. It would have been possible to save the last two

buildings of Uravan as a museum and memorial had top-down corporate decision making gone another way.

Furthermore, the case of Orange, New Jersey suggests that careful conservation of contaminated structures can be accomplished without compromising on human health. With enough time, funding, and expertise, buildings can be left largely intact, and the historic built environment can be restored to its previous condition. Engineers, masons, and others already deal with similar problems everyday - shoring up basement walls, repointing brick, replacing soil. It ought to be possible to develop a better technical conservation approach to these cases, so that there are clear and established guidelines for completing remediation work in historic structures without simply demolishing the building. Even when buildings are lost, as in Uravan, Colorado, and Ottawa, Illinois, community-driven interpretation efforts can still effectively convey important histories. Simple interventions such as the installation of a statue or memorial can have an important impact.

Some buildings are more radioactive than others, and in those cases it may not be possible or practical to save them as they stand. However, the long life of nuclear contamination means that the material that made up these buildings - the walls, concrete floor, rough timbers - cannot be fully destroyed. Even in cases where buildings are too contaminated to be saved, it is likely that some built fabric remains somewhere, in some form. This opens up a broad range of possibilities and an entire spectrum of possible interpretive solutions, not the least of which is interpreting these histories away from the primary site of contamination in addition to where they previously stood. There are many more creative ways of telling the stories of these histories that have just begun to be explored.

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